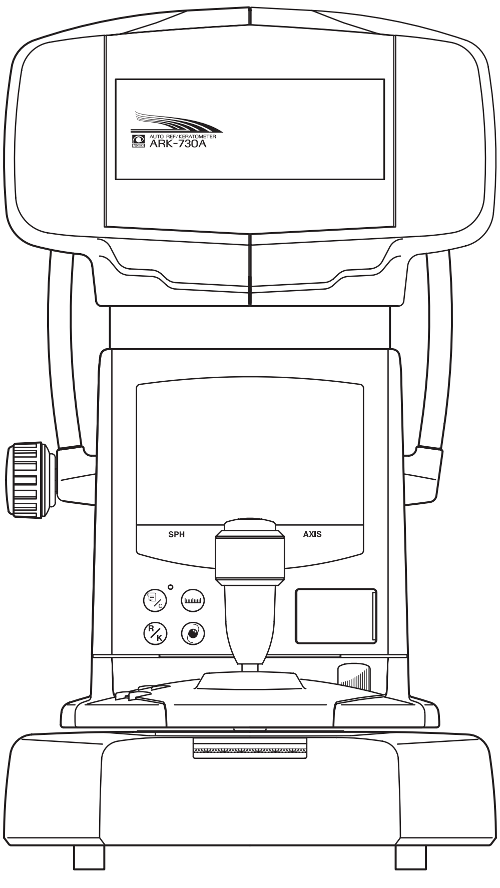
NIDEK

AUTO REF/KERATOMETER

Model ARK- 730A

SERVICE MANUAL



NIDEK CO., LTD.

December 3, 2003
MRK4C*RDA001A/E
82 pages in total

Table of Contents

§1 INTRODUCTION

This service manual contains service instructions for the NIDEK AUTO REF/KERATOMETER, ARK-730A.

For correct service, thorough understanding of the contents of this manual is required prior to the service. In this manual, simple replacement work of various units is described as countermeasures against troubles.

The disassembling and repair work must be performed by NIDEK service personnel, or technicians trained for the service work of the ARK-730A by NIDEK.

Use this manual together with the ARK-730A Operator's Manual.

The specifications and design of this instrument are subject to change without notice for improvement. In the case of major changes, refer to the corresponding TECHNICAL BULLETIN issued in each occasion.

If the instrument cannot be repaired by repair operations in accordance with this Service Manual, please inform NIDEK of the Serial Number of the instrument, and details of the symptom. If the measurement is possible, please inform NIDEK of the data of the model eyes (-10D, 0D, +10D) and steel balls (5.95 mm, 7.94 mm, 9.13 mm).

§2 SAFETY

2.1 General Precautions

- Only service persons who are accustomed to using the required tools and have a deep knowledge of this instrument are allowed to repair the instrument.

- Observe the procedures to perform the repair work. If not, accidents or failure of the instrument may result.

- When performing the maintenance work, turn OFF the power switch, and disconnect the power cord from the wall outlet unless the power needs to be ON.

- Never wipe the covers etc. using an organic solvent such as a paint thinner. The surface may be damaged, and the appearance of the instrument will be impaired as a result.

- For procedures similar to the ones of the AR-630A, “see “*.*” of the AR-630A Service Manual.” will be described in this manual. Use the AR-630A Service Manual together with this manual.

2.2 Maintenance Precautions

- In case of instrument malfunction, turn OFF the power switch after checking the symptom.

- Never drop parts or screws inside the instrument, nor bump it against surrounding objects.

- Prepare storage cases so as not to lose the removed screws or parts.

- Screw or unscrew the screws with proper tools.

- After loosening the screws fixed by a thread-locking adhesive, be sure to reapply the thread-locking adhesive to the screws when you retighten them.

- After replacing parts, make sure that they are fixed securely before turning ON the power.

- If you observe strange odors or smoke being issued from the instrument, immediately turn OFF the instrument, disconnect the power cord from the outlet, and isolate the cause. If the instrument is powered in abnormal conditions, fire, electric shock or total loss of the instrument may result.

- Refer to “9.1 Wiring Diagram” and “9.2 Connecting Cables,” for checking cable breaks as described in “§3 TROUBLESHOOTING”. In addition, check cables for the following:

  ① Connectors are connected and crimped securely.

  ② No contact failure occurs after re-connection of connectors.

  ③ Cables are soldered properly.
- Do not pull the cables strongly. Cable breaks etc. may result.
- Never perform maintenance work with wet hands. Electric shock or failure of the instrument may result.

2.3 Adjustment Precautions

- Perform adjustment on a vibration-free, stable and level surface.
  A slanted floor or place subject to vibration will obstruct accurate adjustment.
- Never use adjustment jigs for purposes not instructed in this manual.

§3 TROUBLESHOOTING

Connect the power cord to a wall outlet and turn ON the power switch.

Does the initialization complete and do the SPH, CYL and Axis values indicate “0”?
- No → 4.1 The TV monitor displays nothing. / The TV monitor display is abnormal.
  4.2 The “ERR” message appears after turning ON the power switch.
- Yes ↓

Does the TV monitor brighten up?
- No → 4.3 The TV monitor does not brighten up.
- Yes ↓

Does the eye image appear on the TV monitor?
- No → 4.4 The eye image does not appear on the TV monitor.
- Yes ↓

Do the characters appear on the TV monitor clearly?
- No → 4.5 The characters or target are not clear or they are not indicated on the TV monitor.
- Yes ↓

Press the 3D Auto button.

↓

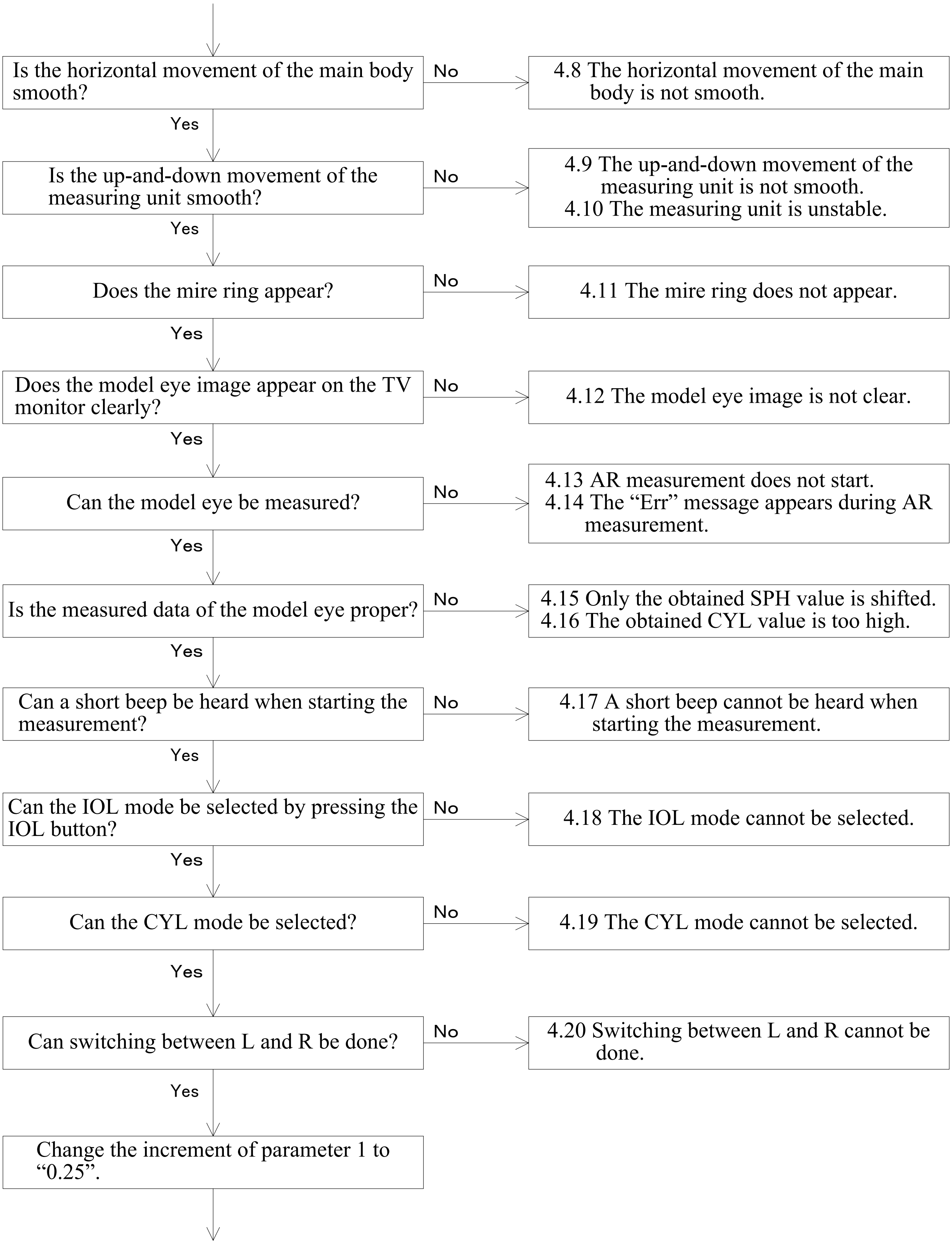
Can the manual mode be selected?
- No → 4.6 Switching between the manual mode and auto tracking mode cannot be done.
- Yes ↓

Can the increments of parameter 1 be changed to 0.01?
- No → 4.7 The parameter cannot be changed.
- Yes ↓

Can the “R” measurement mode be selected?
- No → 4.33 The switching of R/K measurement mode can not be done.
- Yes ↓

Attach the model eye to the chin rest.

↓


Is the horizontal movement of the main body smooth?
No
4.8 The horizontal movement of the main body is not smooth.
Yes
Is the up-and-down movement of the measuring unit smooth?
No
4.9 The up-and-down movement of the measuring unit is not smooth.
4.10 The measuring unit is unstable.
Yes
Does the mire ring appear?
No
4.11 The mire ring does not appear.
Yes
Does the model eye image appear on the TV monitor clearly?
No
4.12 The model eye image is not clear.
Yes
Can the model eye be measured?
No
4.13 AR measurement does not start.
4.14 The “Err” message appears during AR measurement.
Yes
Is the measured data of the model eye proper?
No
4.15 Only the obtained SPH value is shifted.
4.16 The obtained CYL value is too high.
Yes
Can a short beep be heard when starting the measurement?
No
4.17 A short beep cannot be heard when starting the measurement.
Yes
Can the IOL mode be selected by pressing the IOL button?
No
4.18 The IOL mode cannot be selected.
Yes
Can the CYL mode be selected?
No
4.19 The CYL mode cannot be selected.
Yes
Can switching between L and R be done?
No
4.20 Switching between L and R cannot be done.
Yes
Change the increment of parameter 1 to “0.25”.

Press the Change button.

↓

Attach a scale to the model eye.

↓

Can the PD measurement be performed? — No → 4.21 The PD mode cannot be established. 4.22 The value obtained by the PD measurement is abnormal.

Yes ↓

Can the “K” measurement mode be selected? — No → 4.33 Switching of the R/K measurement mode cannot be done.

Yes ↓

Can the steel ball be measured? — No → 4.34 The “Err” message appears during the KM measurement.

Yes ↓

Is the obtained measurement data of the steel ball proper? — No → 4.35 The data obtained by the KM measurement is abnormal.

Yes ↓

Press the Change button to select the “R/K” measurement mode.

↓

Measure the human eye for check.

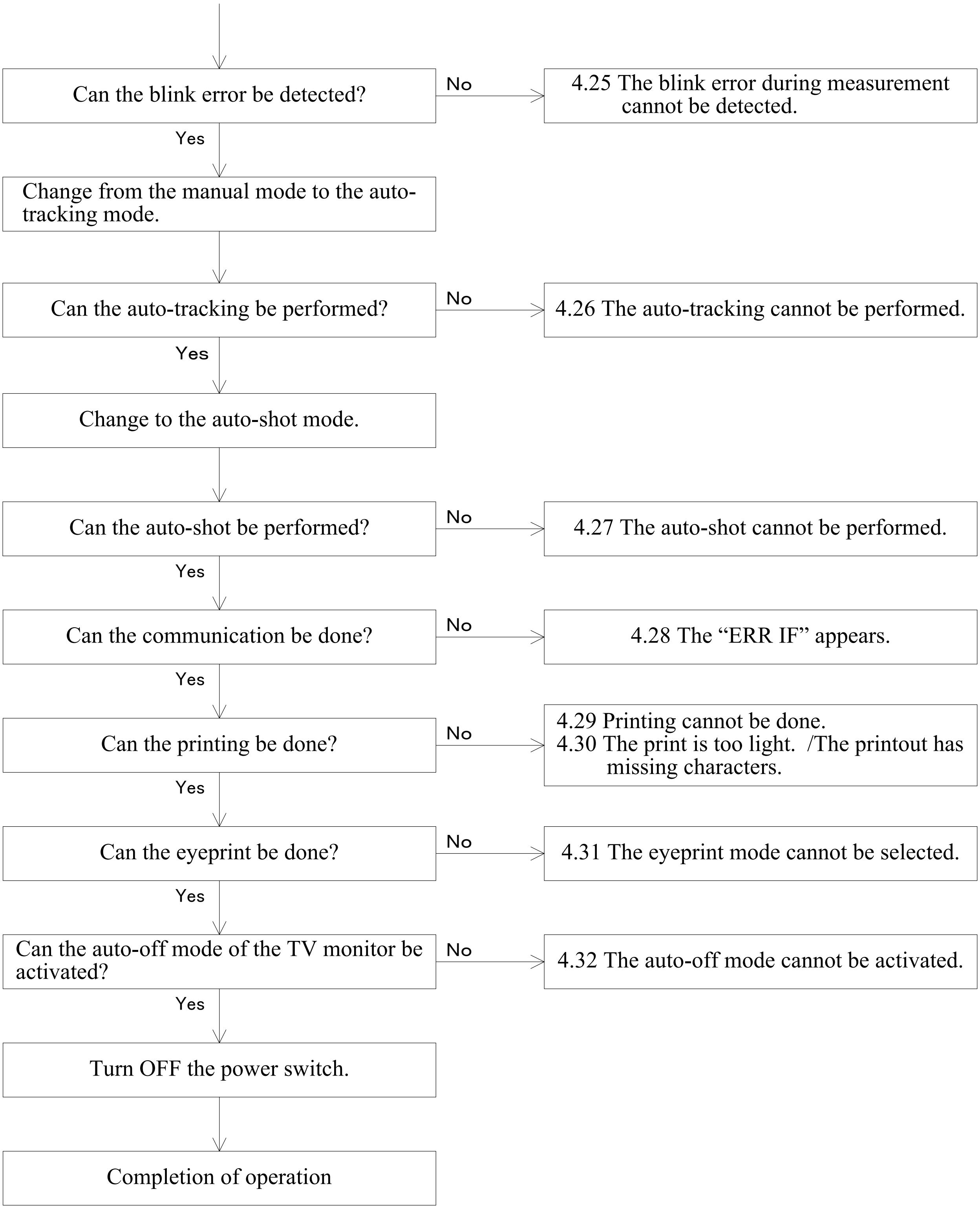
↓

Is the up-and-down movement of the chin rest smooth? — No → 4.23 The up-and-down movement of the chin rest is not smooth.

Yes ↓

Can the chart be seen through the measuring window? — No → 4.24 The chart cannot be seen.

Yes ↓


Can the blink error be detected?
No
4.25 The blink error during measurement cannot be detected.
Yes
Change from the manual mode to the auto-tracking mode.
Can the auto-tracking be performed?
No
4.26 The auto-tracking cannot be performed.
Yes
Change to the auto-shot mode.
Can the auto-shot be performed?
No
4.27 The auto-shot cannot be performed.
Yes
Can the communication be done?
No
4.28 The “ERR IF” appears.
Yes
Can the printing be done?
No
4.29 Printing cannot be done.
4.30 The print is too light. /The printout has missing characters.
Yes
Can the eyeprint be done?
No
4.31 The eyeprint mode cannot be selected.
Yes
Can the auto-off mode of the TV monitor be activated?
No
4.32 The auto-off mode cannot be activated.
Yes
Turn OFF the power switch.
Completion of operation

§4 SUB-TROUBLESHOOTING

4.1 The TV monitor displays nothing. / The TV monitor display is abnormal.

Is the fuse proper?
- No → Replace the fuse. (Refer to the Operator's Manual.)
- Yes ↓

Is the voltage supplied to the AC INLET proper?
- No → It is recommended to install a voltage regulator.
- Yes ↓

Do the following connectors have poor electrical contact?
BA01 board: P103 (J3), P104 (J4)
BA02 board: P201 (J1)
BA07 board: P701 (J1), P702 (J2)
- Yes → Re-connect the connector.
- No ↓

Is the voltage supplied to P701 (J1) on the BA07 board proper?
1st - 2nd pins: 14VAC
3rd - 4th pins: 18VAC
5th - 6th pins: 18VAC
7th - 8th pins: 18VAC
9th - 10th pins: 10VAC
- No → Replace the transformer. (See "7.1".)
- Yes ↓

Is the voltage supplied to P702 (J2) on the BA07 board proper?
1st - 2nd pins: +15VDC
5th - 6th pins: +15VDC
7th - 6th pins: -15VDC
3rd - 4th pins: +5VDC
10th - 4th pins: +5VDC
8th - 9th pins: +12VDC
- No → Replace the BA07 board. (See "6.4".)
- Yes ↓

Does the power I/F cable (32906-EA59) have a breakage?
- Yes → Repair the power I/F cable (32906-EA59) or replace it. (See "9.2".)
- No ↓

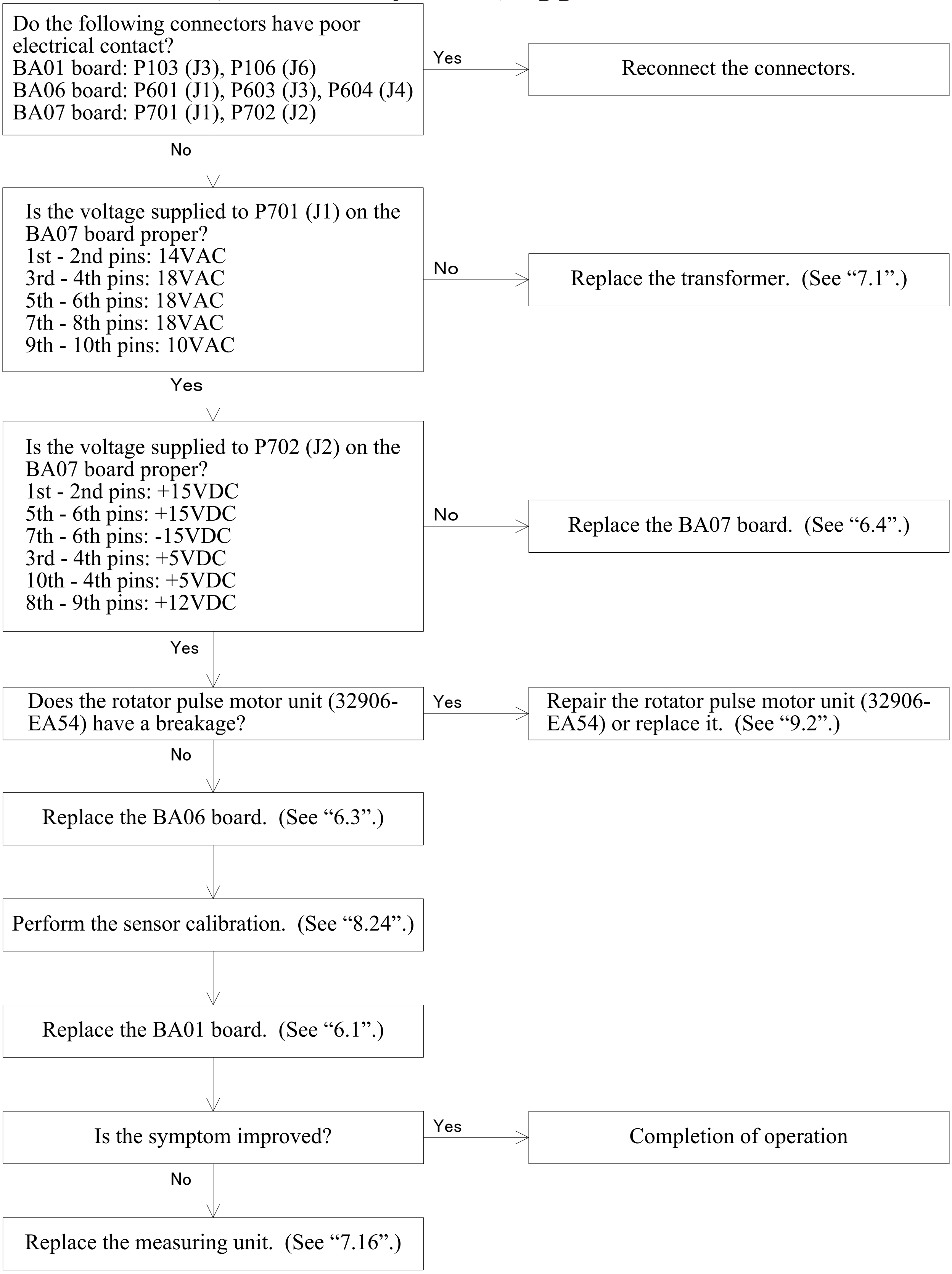
Does the DISPLAY cable (32906-EA31) have a breakage?
- Yes → Repair the DISPLAY cable (32906-EA31) or replace it. (See "9.2".)
- No ↓

Replace the BA01 board. (See "6.1".)
↓

Replace the BA02 board. (See "6.2".)

4.2 The “ERR” message appears after turning ON the power switch.

4.2.1 “Err 1” (sensor carry error) appears.



4.2.2 “Err 2” (target carry error) appears.

1. Do the following connectors have poor electrical contact?
   BA01 board: P107 (J7)
   BA06 board: P601 (J1), P607 (J7), P608 (J8)
   - Yes → Reconnect the connectors.
   - No → go to 2.

2. Does the voltage of the connector below change from 0V to +5V when the interrupting plate interrupts PI1 of the target origin unit (32906-EA36)?
   BA06 board: 3rd - 4th pins of P608 (J8)
   - No → Replace the target origin unit (32906-EA36). (See “9.2”.)
   - Yes → go to 3.

3. Does the PC1 to PC6 cable (32906-EA64) have a breakage?
   - Yes → Repair the PC1 to PC6 cable (32906-EA64) or replace it. (See “9.2”.)
   - No → go to 4.

4. Replace the BA06 board. (See “6.3”.)

5. Perform the sensor calibration. (See “8.24”.)

6. Replace the BA01 board. (See “6.1”.)

7. Is the symptom improved?
   - Yes → Completion of operation
   - No → Replace the measuring unit. (See “7.16”.)

4.2.3 "Err 3" (rotator error) appears.

Do the following connectors have poor electrical contact?
BA01 board: P107 (J7)
BA06 board: P601 (J1), P606 (J6)

- Yes → Reconnect the connectors.
- No ↓

Does the voltage of the connector below change from 0V to +5V when the interrupting plate interrupts PI1 of the rotator pulse motor unit (32906-EA55)?
BA06 board: 9th - 10th pins of P606 (J6)

- No → Replace the rotator pulse motor unit (32906-EA55). (See "9.2".)
- Yes ↓

Does the PC1 to PC6 cable (32906-EA64) have a breakage?

- Yes → Repair the PC1 to PC6 cable (32906-EA64) or replace it. (See "9.2".)
- No ↓

Replace the BA06 board.
(See "6.3".)

↓

Perform the sensor calibration.
(See "8.24".)

↓

Replace the BA01 board.
(See "6.1".)

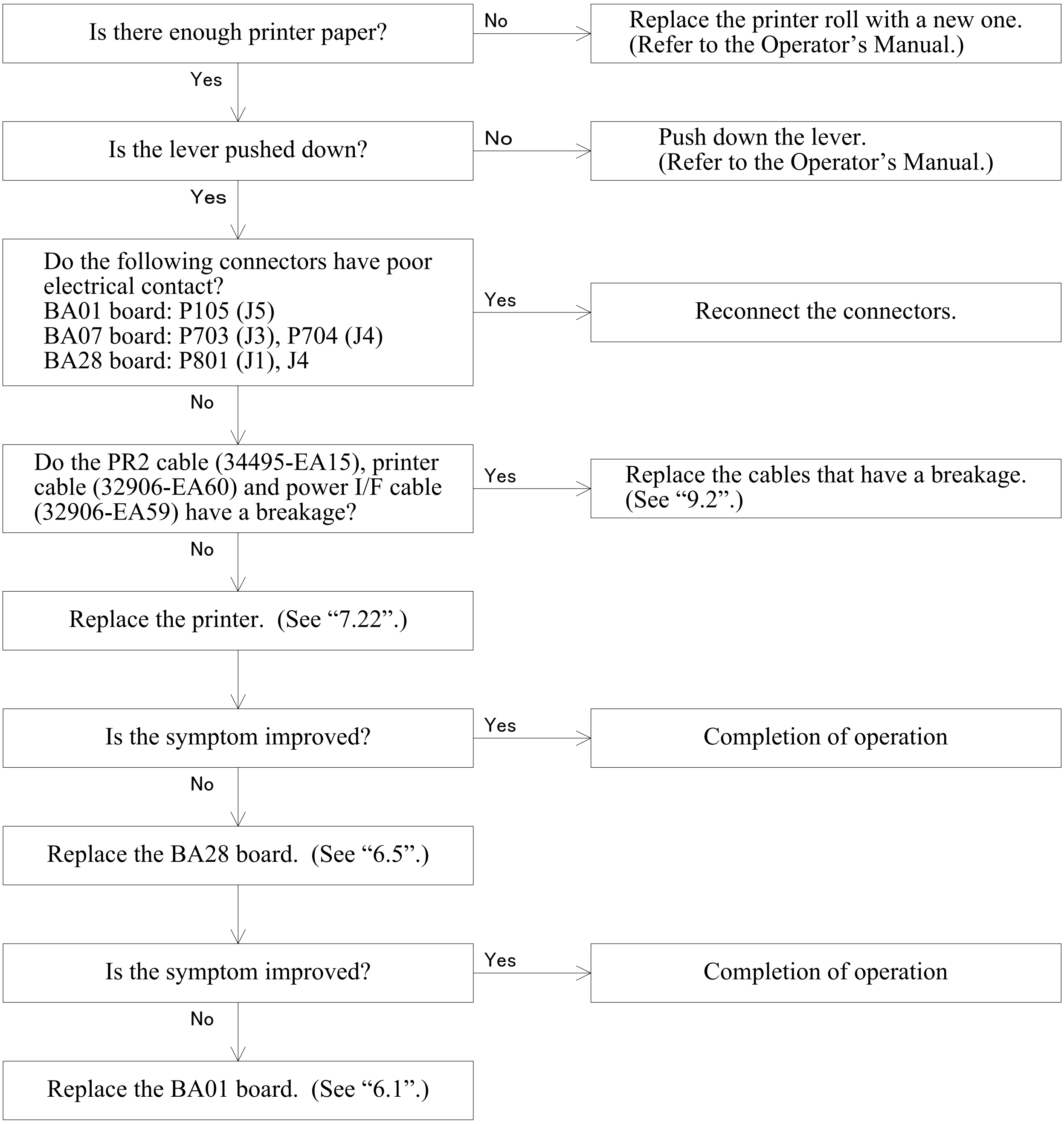
↓

Is the symptom improved?

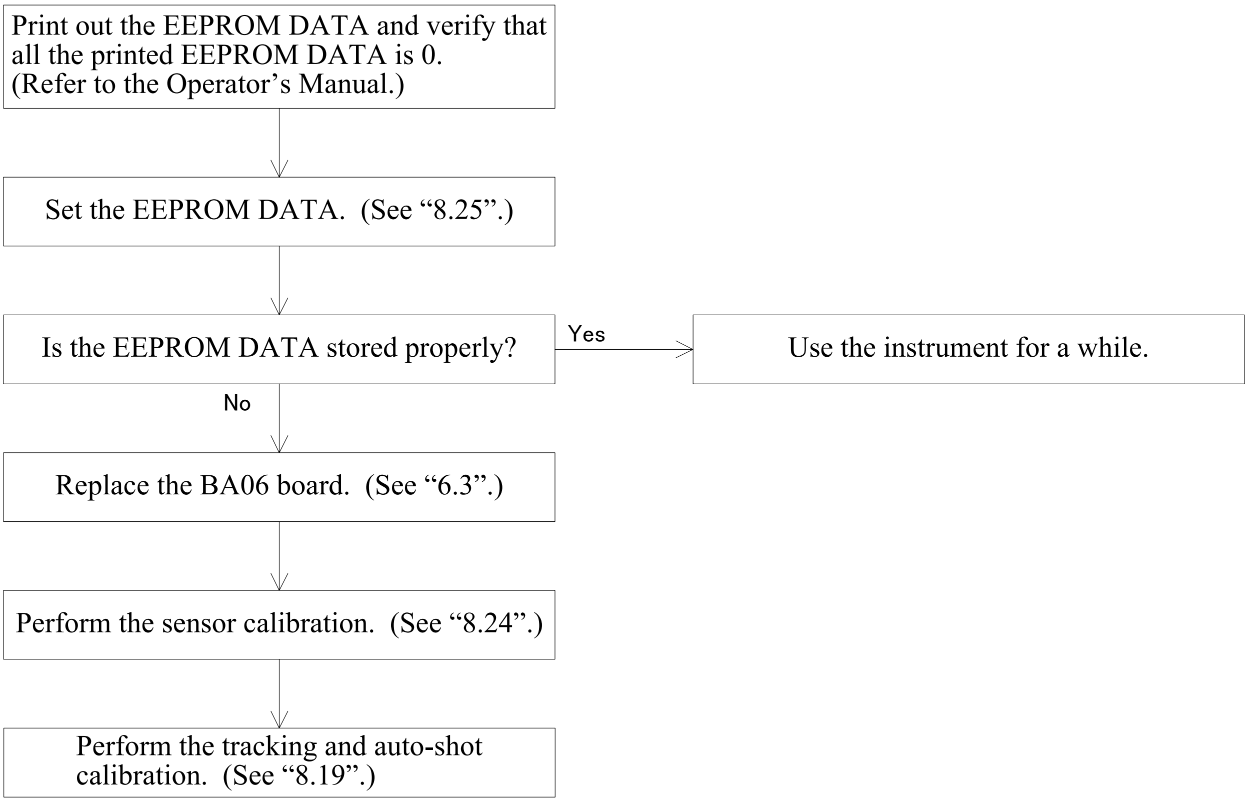
- Yes → Completion of operation
- No ↓

Replace the measuring unit.
(See "7.16".)

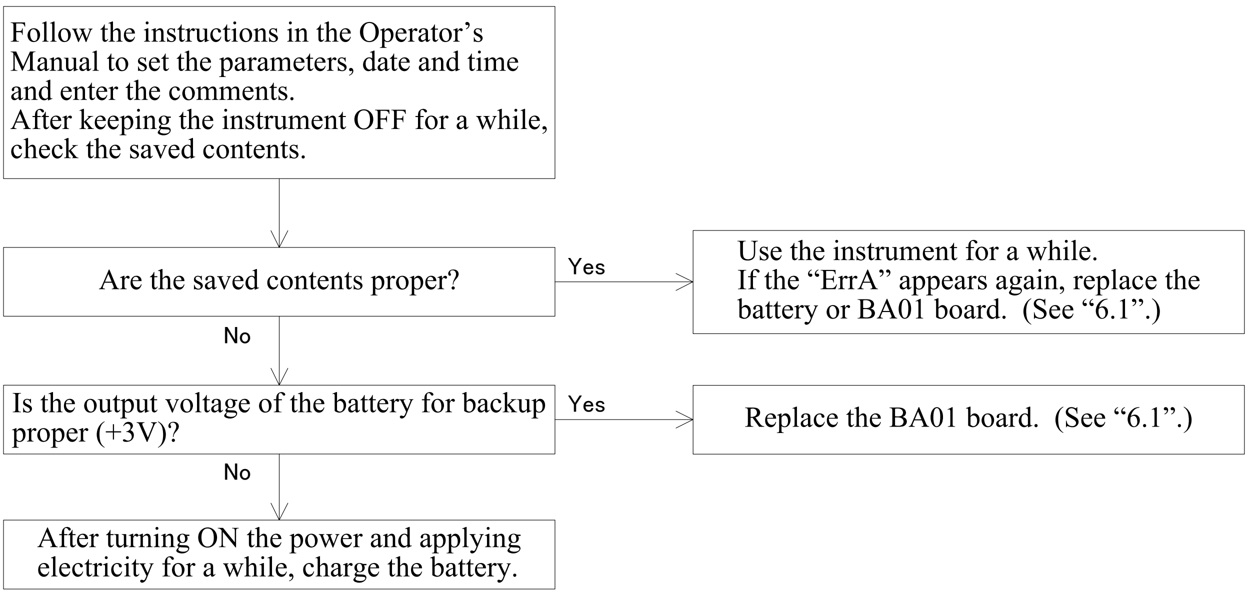
4.2.4 “Err 7” (printer error) appears.



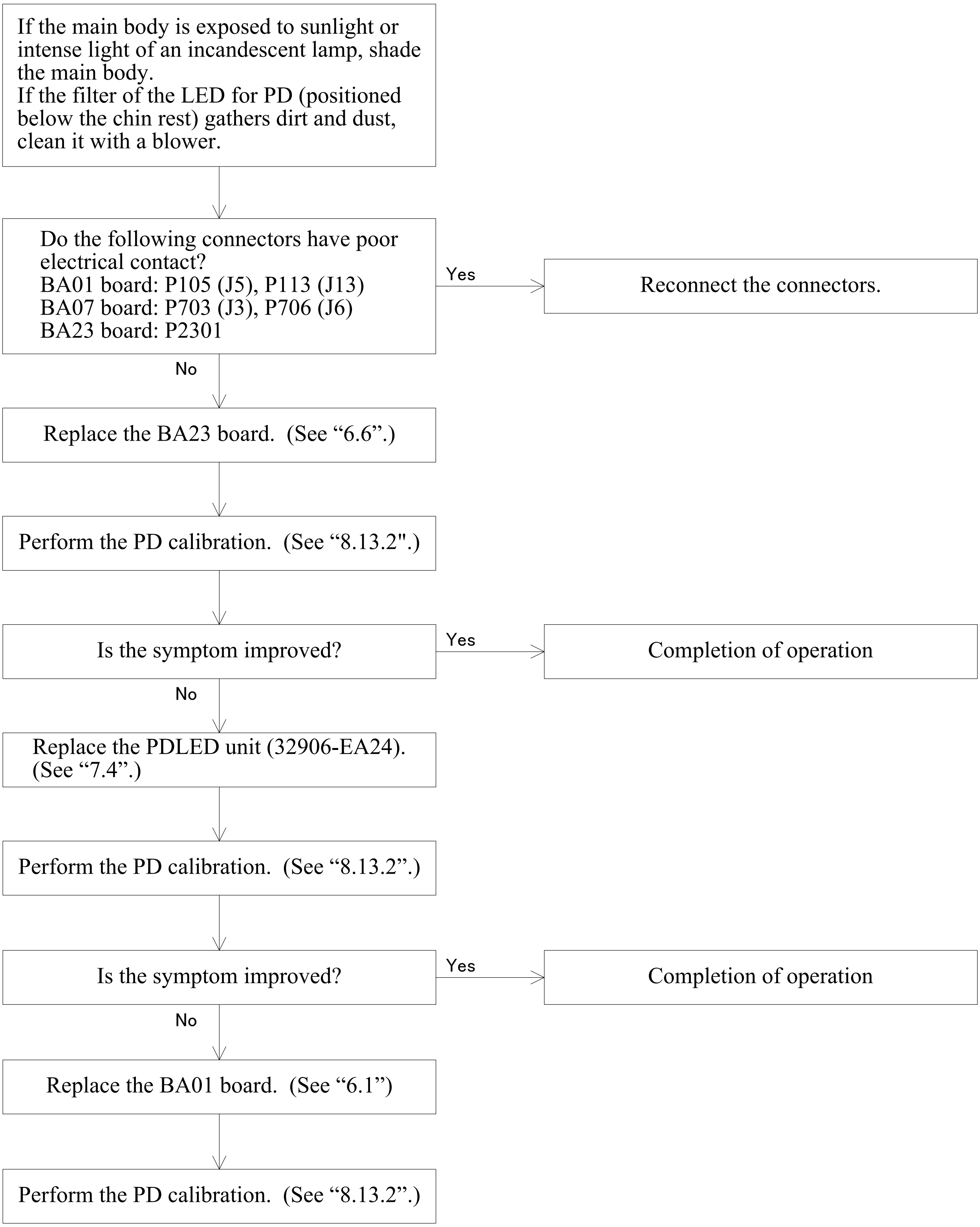
4.2.5 “Err 9” (MEMORY FAILURE ON EEPROM) appears.



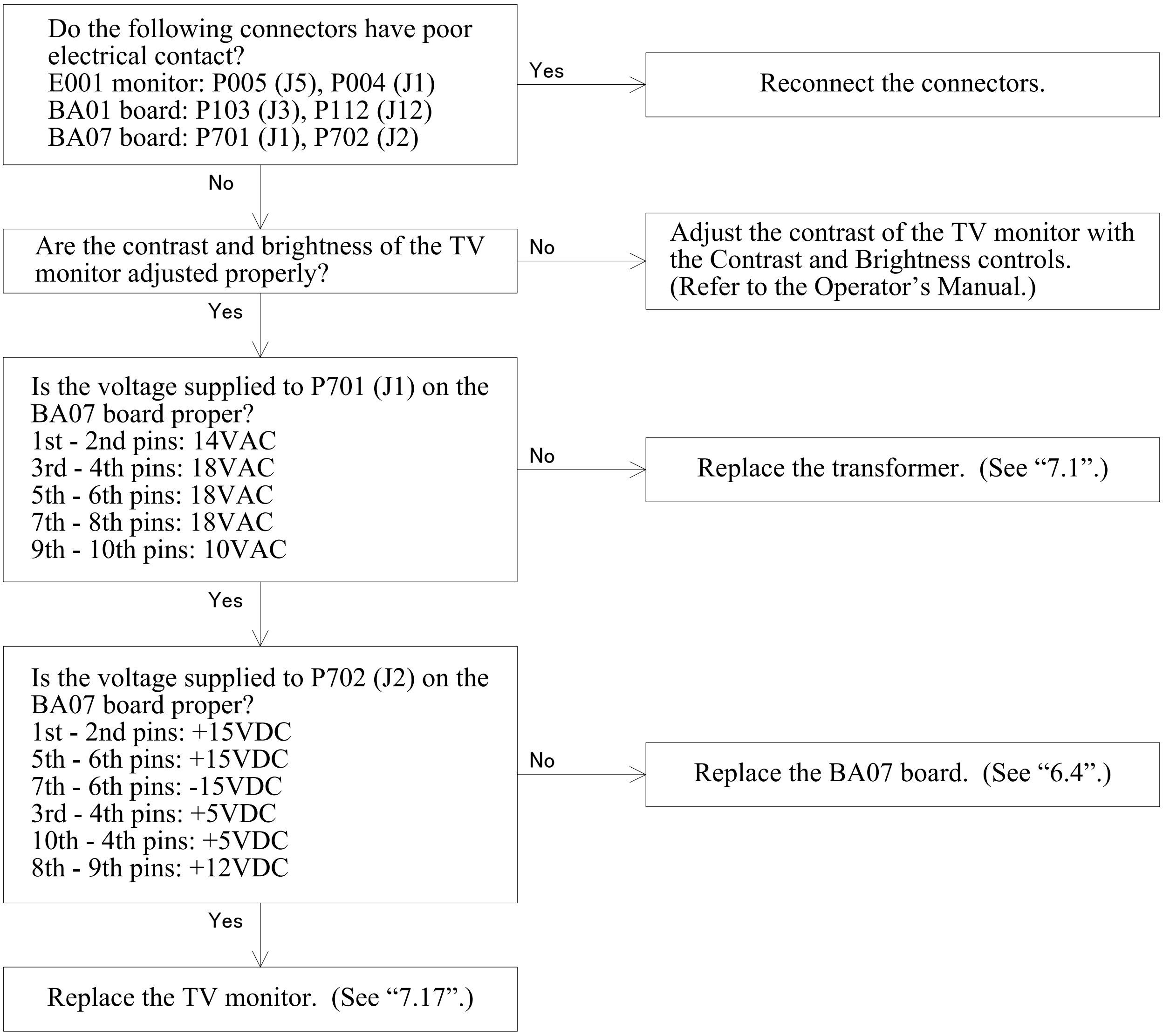
4.2.6 “Err A” (MEMORY FAILURE ON RAM) appears.



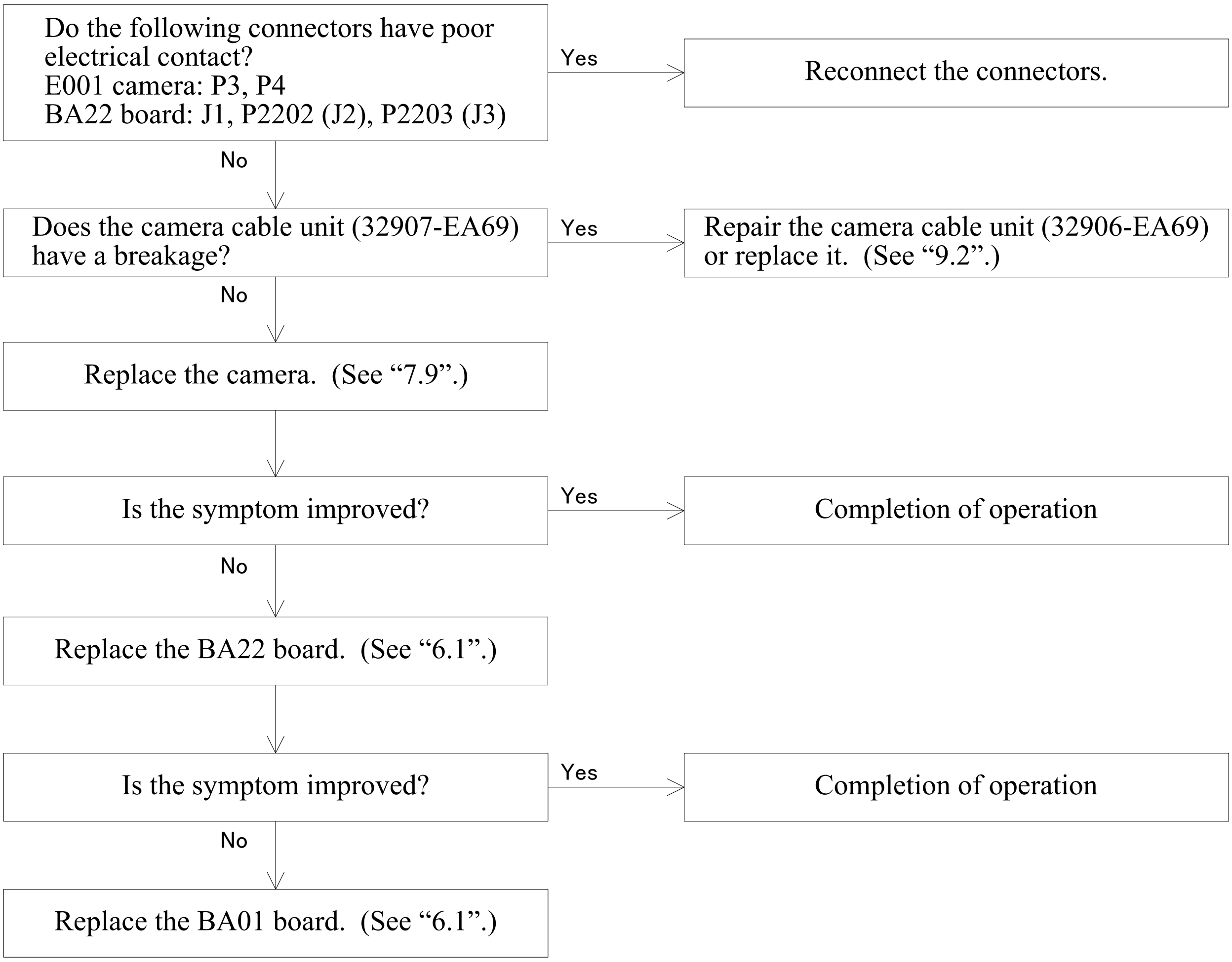
4.2.7 “PD ERR” appears.



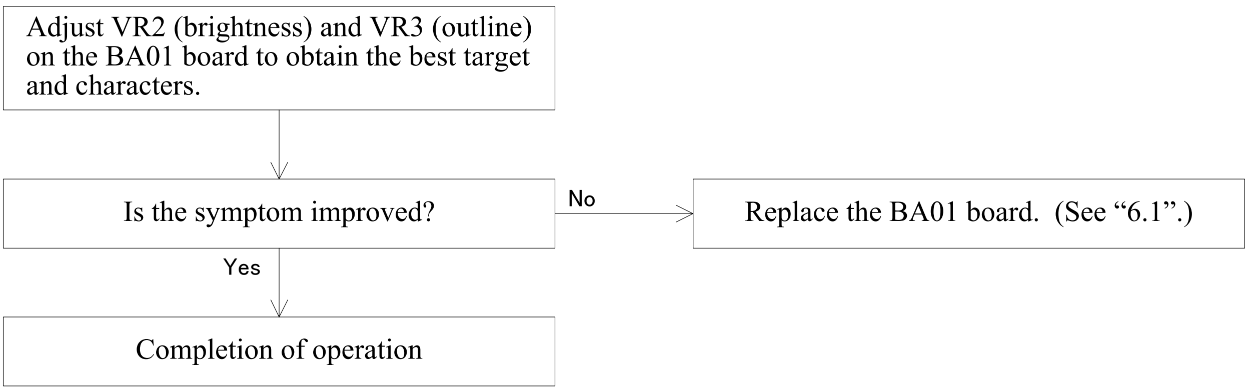
4.3 The TV monitor does not brighten up.



4.4 The eye image does not appear on the TV monitor.



4.5 The characters and target are not clear or they are not indicated on the TV monitor.



4.6 Switching between the manual mode and auto-tracking mode cannot be done.

Do the following connectors have poor electrical contact?
BA01 board: P104 (J4)
BA02 board: P201 (J1), P203 (J3)

- Yes → Reconnect the connectors.
- No ↓

Does the INC/DEC SW unit (32907-EA03) have a breakage?

- Yes → Repair the INC/DEC SW unit (32907-EA03) or replace it. (See “7.5” and “9.2”.)
- No ↓

Is the symptom improved?

- Yes → Completion of operation
- No ↓

Replace the BA02 board. (See “6.2”.)

↓

Does the DISPLAY cable (32906-EA31) have a breakage?

- Yes → Repair the DISPLAY cable (32906-EA31) or replace it. (See “9.2”.)
- No ↓

Replace the BA01 board. (See “6.1”.)

4.7 The parameter cannot be changed.

Do the following connectors have poor electrical contact?
BA01 board: P104 (J4)
BA02 board: P201 (J1), P203 (J3)

- Yes → Reconnect the connectors.
- No ↓

Is electricity applied between the B10 - B11 pins of the P104 connector when pressing the Setting button on the BA02 board?
B10 (-), B11 (+)
* Polarity of tester (“+” and “-”) is described in the parentheses above.

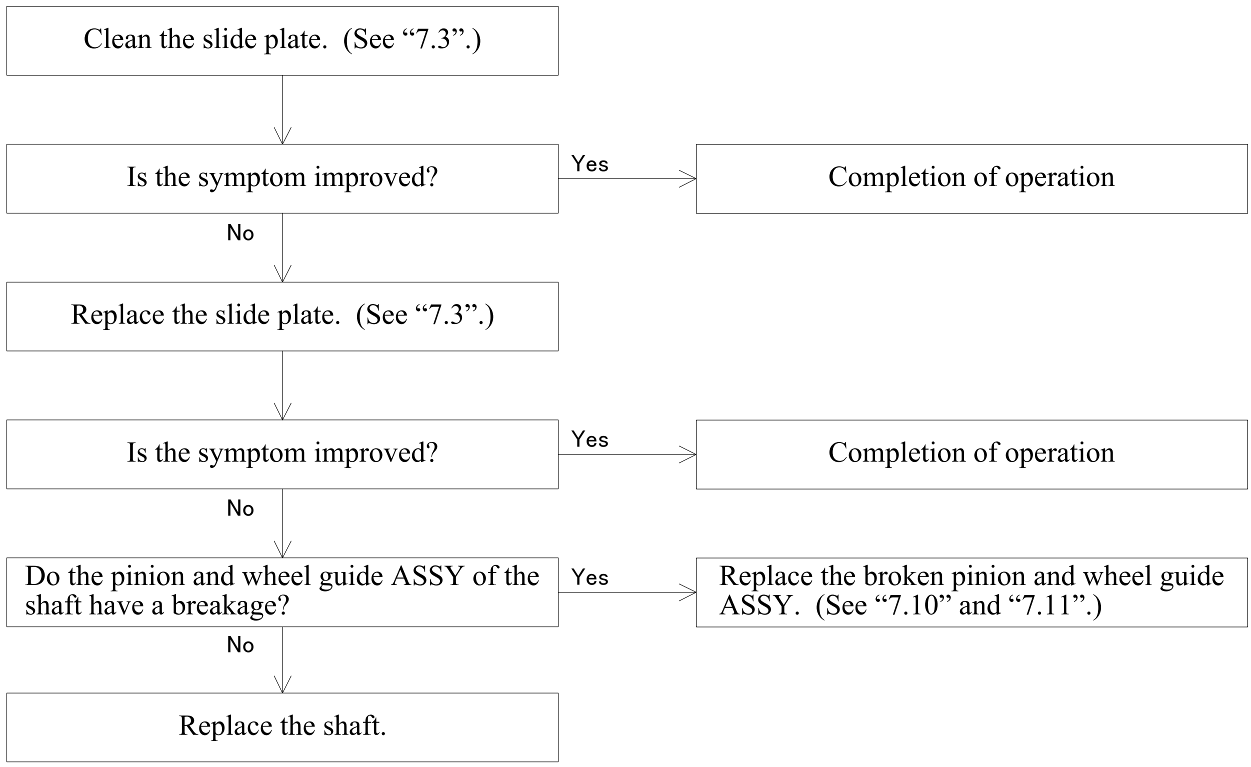
- No → Replace the BA02 board. (See”6.2".)
- Yes ↓

Are the UP and DOWN buttons of the INC/DEC SW unit (32907-EA03) proper?

- No → Replace the INC/DEC SW unit (32907-EA03). (See “7.5”.)
- Yes ↓

Replace the BA01 board. (See “6.1”.)

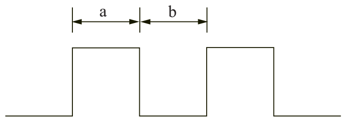
4.8 The horizontal movement of the main body is not smooth.



4.9 The vertical movement of the measuring unit is not smooth.

Can the measuring unit move vertically by manipulating the joystick?

- Yes → Is abnormal sound heard when the measuring unit is positioned at the upper and lower limits?
  - Yes → Replace the U/D limit switch and adjust it. (See “7.15”.)
  - No → Completion of operation
- No → Observe the output voltage between the 3rd - 6th pins of P202 (J2) on the BA02 board by an oscilloscope. Is the waveform of the voltage in a pulse shape as the right figure?
  * The cycle varies according to the manipulating speed of the joystick.
  - No → Replace the joystick. (See “7.2”.)
  - Yes → Do the output voltages between the 1st - GND and 2nd - GND of P2204 (J4) on the BA22 board vary within the range of 0V - 14V when manipulating the joystick?
    * The output voltage of “+” and “-” inverts by turning the joystick C.W. or C.C.W.
    - No → Replace the BA22 board. (See “6.1”.)
    - Yes → Replace the U/D MOTOR unit (32907-EA46). (See “7.14”.)



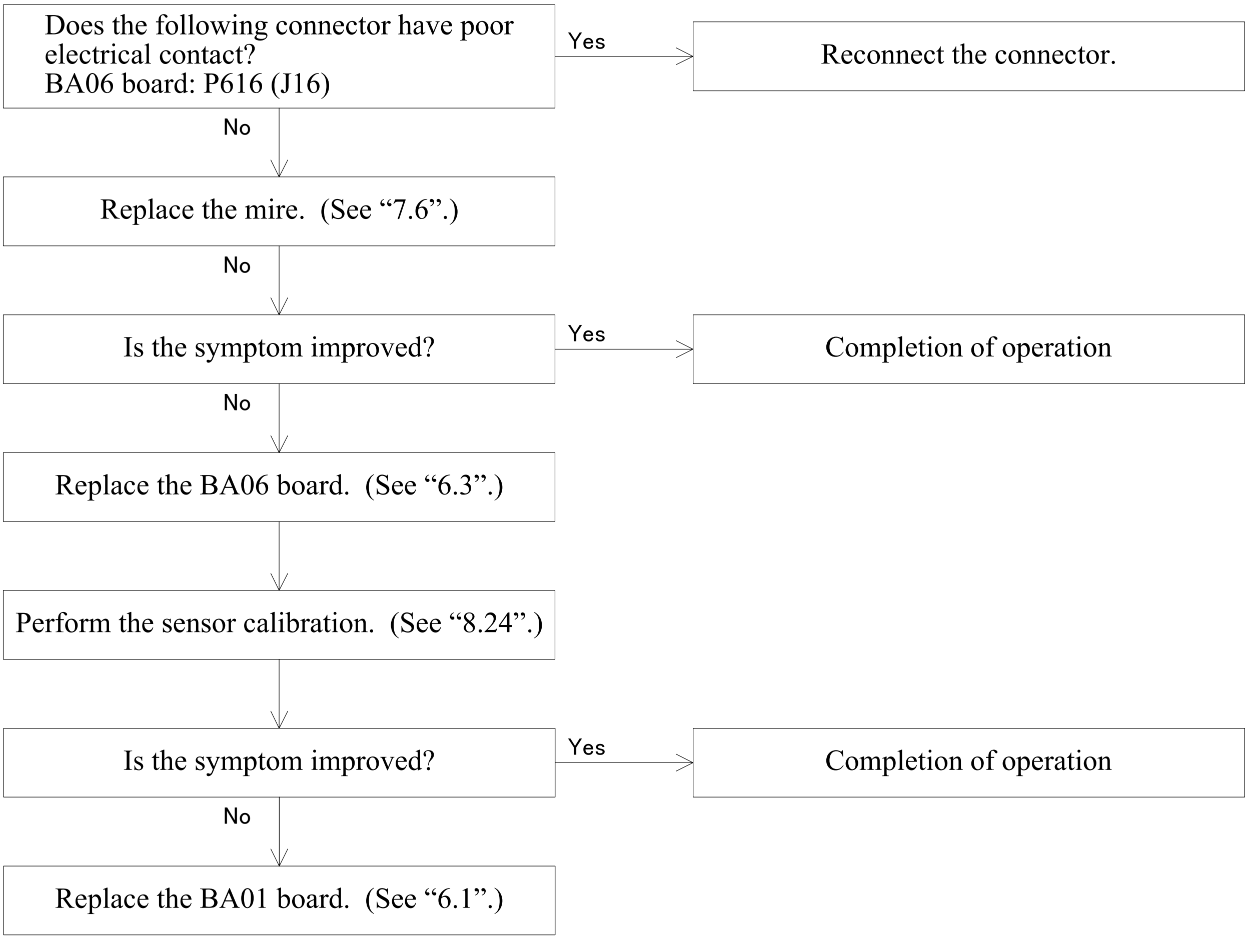
The duty ratio (a : b) should be even.

4.10 The measuring unit is unstable.

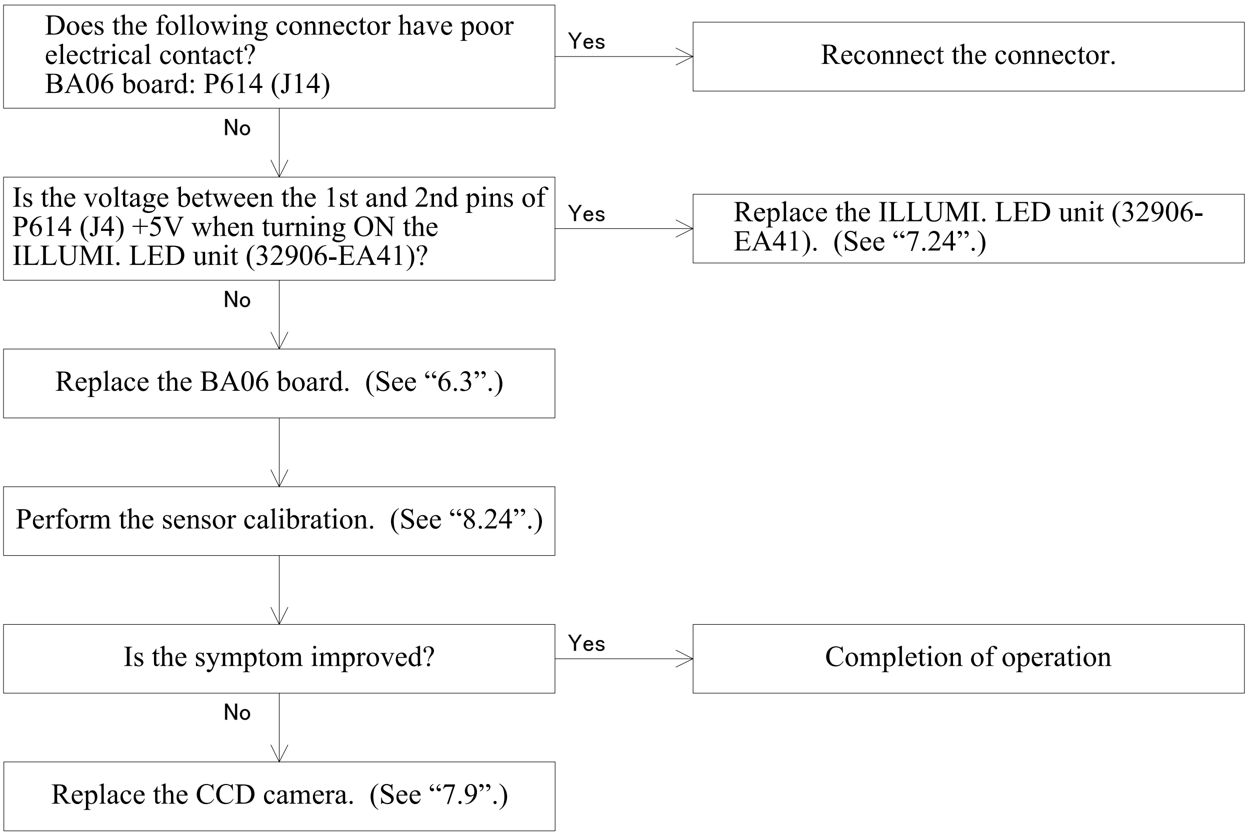
Is SB4 × 6 which fixes the measuring unit loose?

- Yes → Tighten SB4 × 6 retaining the measuring unit. (See “7.16”.)
- No → Is HH3 × 3 which fixes the nut stopper loose?
  - Yes → Adjust the screw which fixes the nut stopper. (See “8.16.1”.)
  - No → Do all 3 bearings for vertical movement rotate when moving the measuring unit upward and downward?
    - No → Adjust the tightness of the screws retaining the up-and-down bearings. (See “8.16.2”.)
    - Yes → Do the bearings have a breakage?
      - No → Adjust the lead screw for up-and-down movement. (See “8.16.3”.)
      - Yes → Replace the bearings. (See “7.13”.)

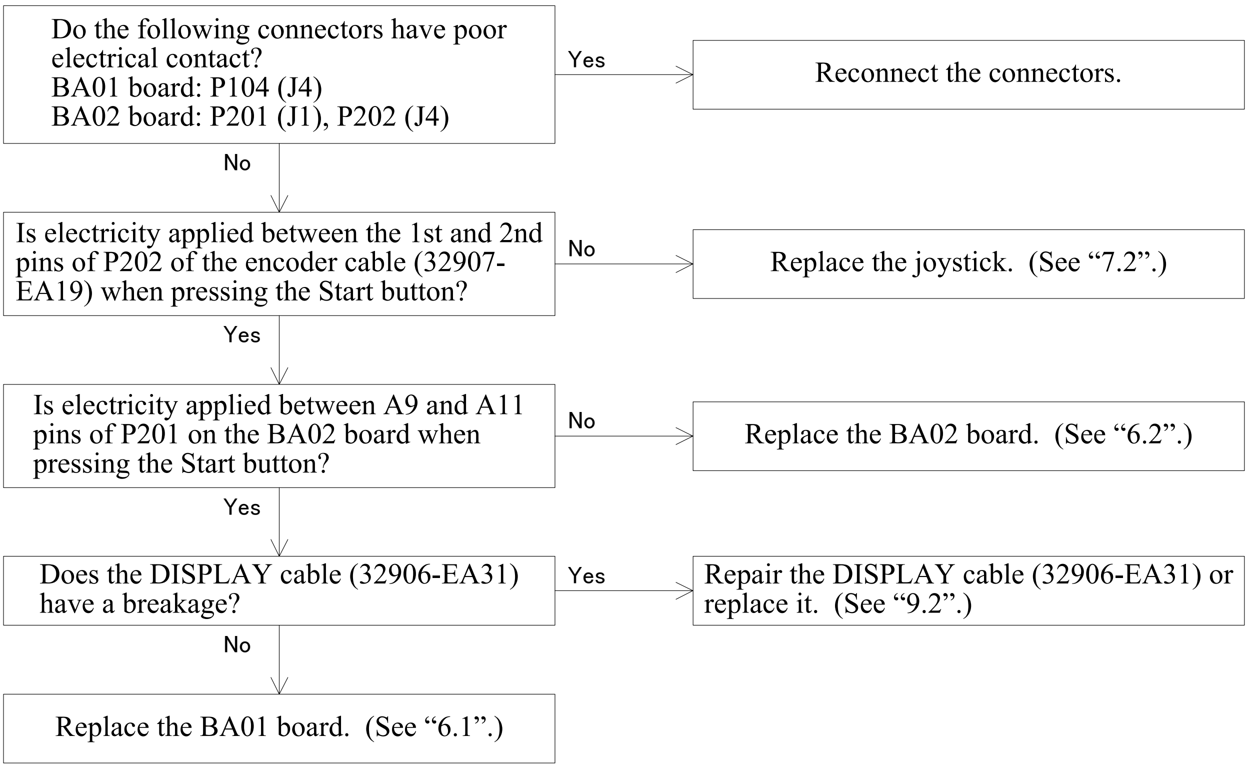
4.11 The mire ring does not appear.



4.12 The model eye image is not clear.



4.13 AR measurement does not start. (The Start button is not operable.)



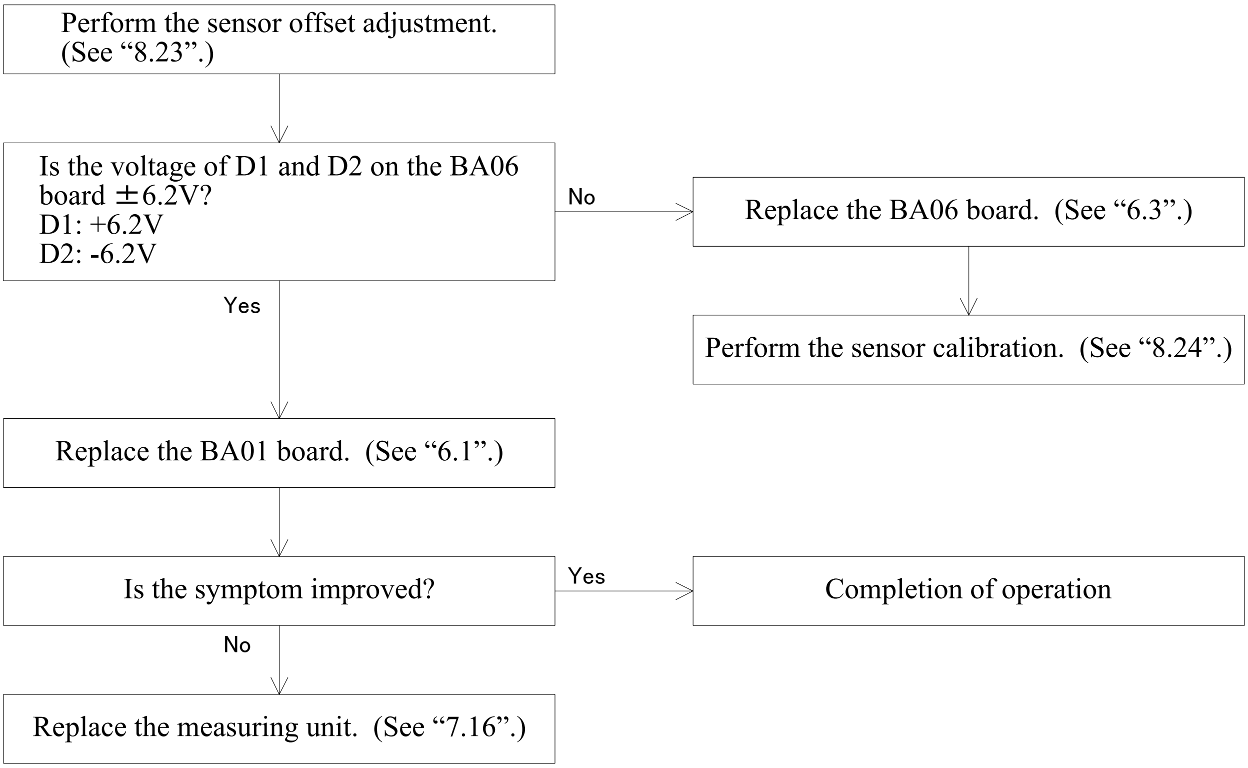
4.14 The "Err" message appears during AR measurement.

1. Do the following connectors have poor electrical contact?
   BA01 board: P101 (J1), P106 (J6)
   BA06 board: P601 (J1), P602 (J2)
   - Yes → Reconnect the connectors.
   - No ↓
2. Does the cable in the LED ASSY (32906-3110) have a breakage?
   * Check the electrical conduction with a tester.
   - Yes → Replace the LED ASSY (32906-3110). (See "7.4".)
   - No ↓
3. Is the position of the target proper?
   - No → Adjust the position of the target. (See "8.4")
   - Yes ↓
4. Replace the BA06 board. (See "6.3".)
5. Perform the sensor calibration. (See "8.24".)
6. Replace the BA01 board. (See "6.1".)
7. Is the symptom improved?
   - Yes → Completion of operation
   - No ↓
8. Replace the measuring unit. (See "7.16".)

Follow the Operator's Manual to set the parameter in order to indicate the Error Code.
(Change the setting of "PARAMETER No. 37: Err Code" from "NO" to "YES".

Err 81: Blink error / blink error detected by the mask signal
Err 82: Blink error / blink error detected by the variation of the S-DIV
Err 83: SGRAD error / error detected by the gradient coefficient
Err 91: SPH + failure / +23D or more (when VD is 12mm)
Err 92: SPH - failure / -20D or less (when VD is 12mm)
Err 93: CYL - failure / 12D or more (when VD is 12mm)
Err 94: CONF. error / the difference between the confidence coefficient and approximate sine curve is wide.

4.15 Only the obtained SPH value is shifted.



4.16 The obtained CYL value is too high.

Do the following connectors have poor electrical contact?
BA01 board: P101 (J1)
BA06: P602 (J2)

- Yes → Reconnect the connectors.
- No ↓

Are the measuring window and model eye completely clean?

- No → Clean the measuring window and model eye. (See "8.17" and "8.18".)
- Yes ↓

Does the cable in the LED ASSY (32906-3110) have a breakage?
* Check the electrical conduction with a tester.

- Yes → Replace the LED ASSY (32906-3110). (See "7.18".)
- No ↓

Is the position of the target proper?

- No → Adjust the position of the target. (See "8.4".)
- Yes ↓

Replace the BA06 board. (See "6.3".)

↓

Perform the sensor calibration. (See "8.24".)

↓

Replace the BA01 board. (See "6.1".)

↓

Is the symptom improved?

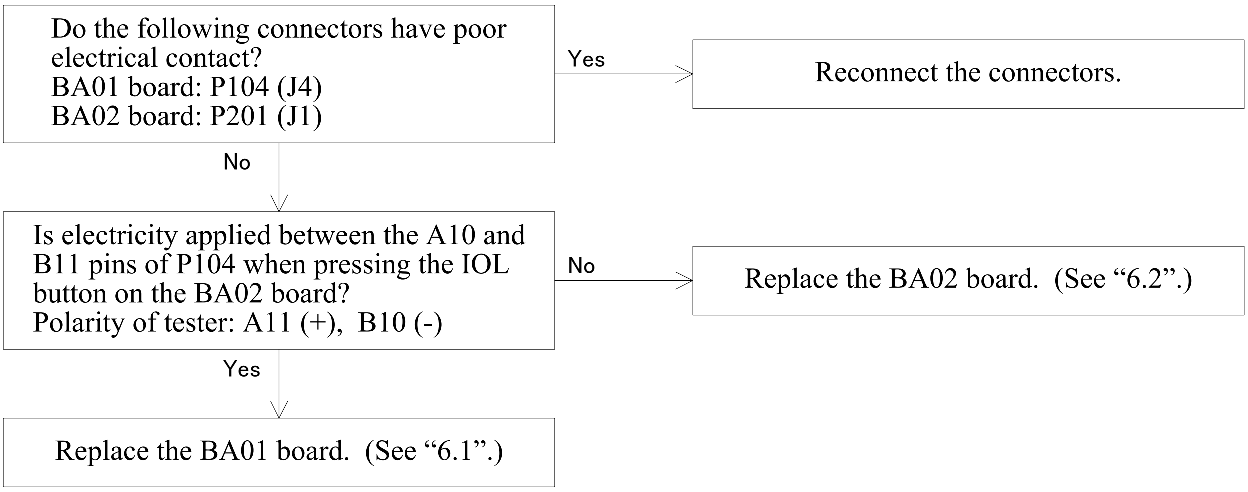
- Yes → Completion of operation
- No ↓

Replace the measuring unit. (See "7.16".)

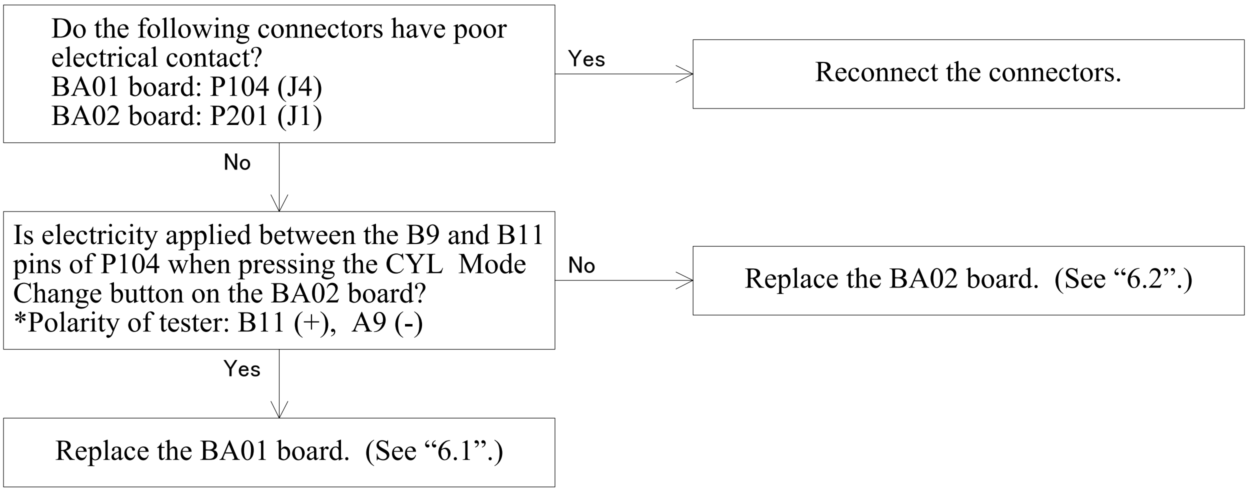
4.17 A short beep cannot be heard when starting the measurement.

Replace the BA01 board. (See “6.1”.)

4.18 The IOL mode cannot be selected.



4.19 The CYL mode cannot be selected.



4.20 Switching between L and R cannot be done.

Do the following connectors have poor electrical contact?
BA01 board: P103 (J3), P113 (J13), P105 (J5)
BA07 board: P706 (J6), P703 (J3)
BA23 board: P2301 (J1)

- Yes → Reconnect the connectors.
- No ↓

Clean the IR filter. (See “7.4”.)

↓

Is the symptom improved?

- Yes → Completion of operation
- No ↓

Is the voltage between the 1st and 2nd pins of P706 (J6) on the BA07 board +5V?

- Yes → Replace the PD LED. (See “7.4”.)
- No ↓

Replace the BA07 board. (See “6.4”.)

↓

Is the symptom improved?

- Yes → Completion of operation
- No ↓

Replace the BA01 board. (See “6.1”.)

4.21 The PD mode cannot be established.

Do the following connectors have poor electrical contact?
BA01 board: P104 (J4)
BA02 board: P201 (J1)

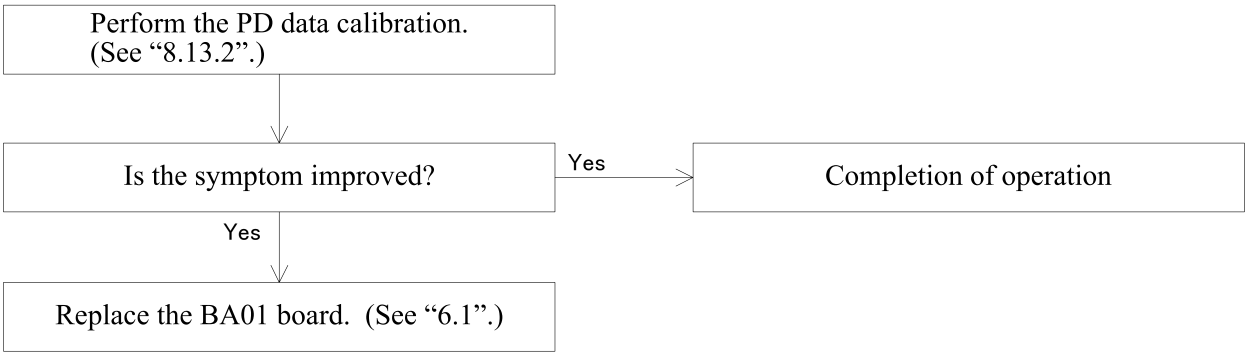
- Yes → Reconnect the connectors.
- No ↓

Is electricity applied between the A9 and B12 pins of P104 when pressing the Change button on the BA02 board?
*Polarity of tester: B12 (+), A9 (-)

- No → Replace the BA02 board. (See “6.2”.)
- Yes ↓

Replace the BA01 board. (See “6.1”.)

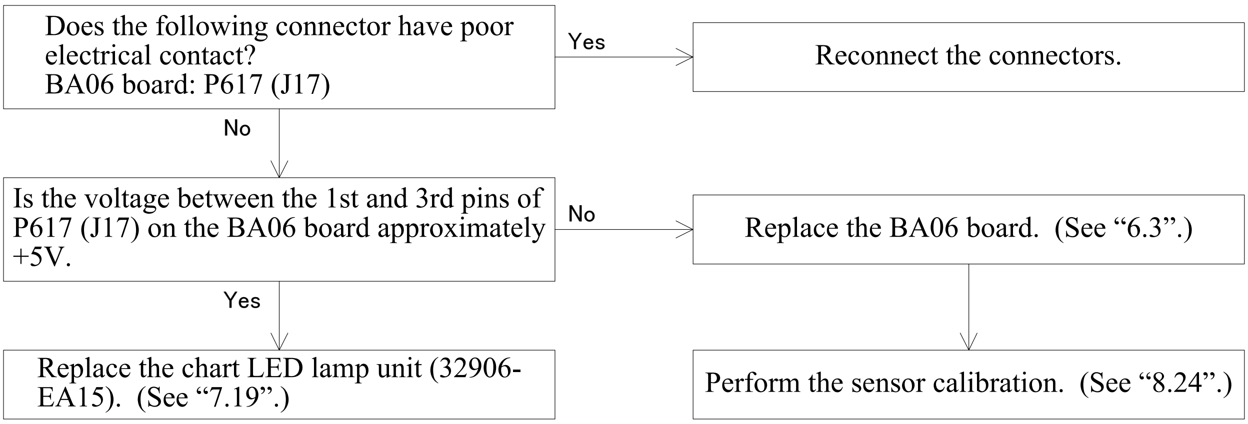
4.22 The value obtained by the PD measurement is abnormal.



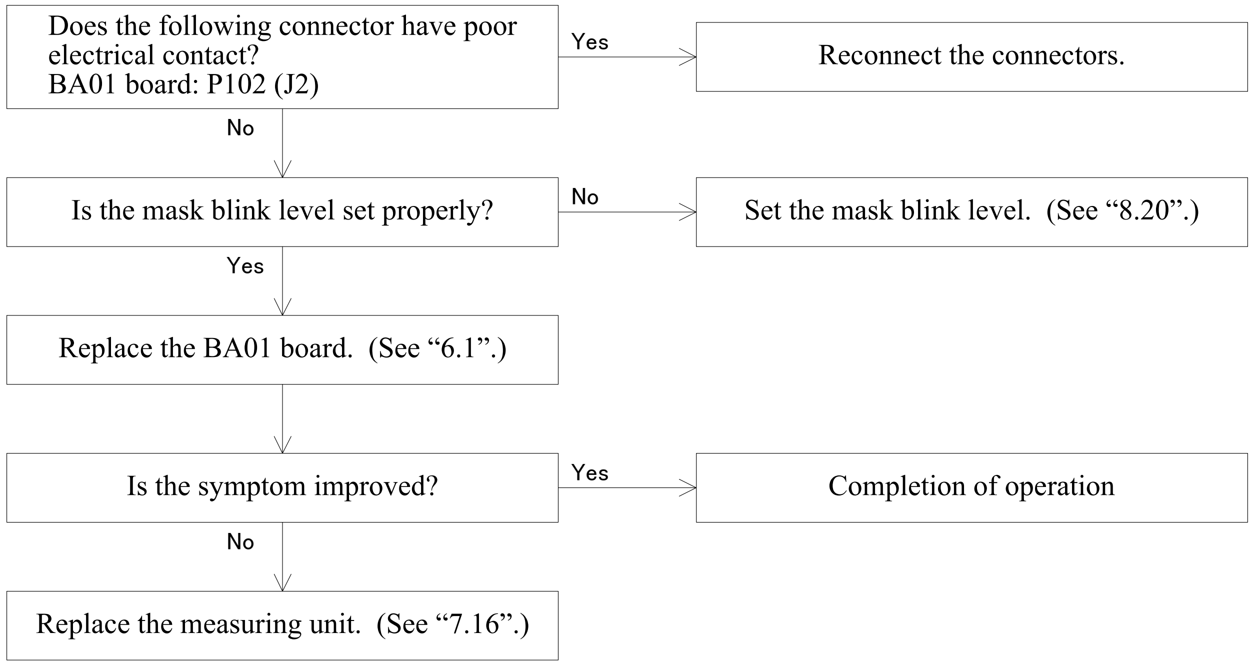
4.23 The up-and-down movement of the chin rest is not smooth.

Adjust the up-and-down movement of the chin rest. (See “8.26”.)

4.24 The chart cannot be seen.



4.25 The blink error is not detected.



4.26 The auto-tracking cannot be performed.

Do the following connectors have poor electrical contact?
BA22 board: P2204 (J4), P2206 (J6),
P2207 (J7), P2201 (J1),
P2205 (J5), P22100 (J100)
BA06 board: P615 (J15), P616 (J16)

- Yes → Reconnect the connectors.
- No ↓

Attach the model eye.

↓

Is abnormal sound heard while the measuring unit moves upward, downward, left, right, backward and forward during auto-tracking?

- Yes → Perform the position adjustment of the TRC LIMIT unit (32906-EA81) and U/D LIMIT unit (32907-EA47), and the auto-tracking adjustment. (See “8.14”.)
- No ↓

Does the voltage of the following connector on the BA22 board change from 0V to +5V when the interrupting plate interrupts PI1 and PI2 of the following LIMITs of the TRC LIMIT unit (32909-EA81)?
RL LIMIT
PI1: 7th (/TP2) - 6th pins of P2207 (J7)
PI2: 3rd (/TP1) - 6th pins of P2207 (J7)
FB LIMIT
PI1: 10th (/TP3) - 12th pins of P2207 (J7)
PI2: 11th (/TP4) - 12th pins of P2207 (J7)

- No → Replace the TRC LIMIT unit (32909-EA81). (See “7.23”.)
- Yes ↓

Does the voltage of the following connectors on the BA22 board change from +5V to 0V when the U/D LIMIT switch of the U/D LIMIT unit is turned ON?
UP LIMIT: 1st - 2nd pins of the P2205 (J5)
LO LIMIT: 3rd - 4th pins of the P2205 (J5)

- No → Replace the U/D LIMIT unit (32907-EA47). (See “7.15”.)
- Yes ↓

Replace the BA22 board. (See “6.1”.)

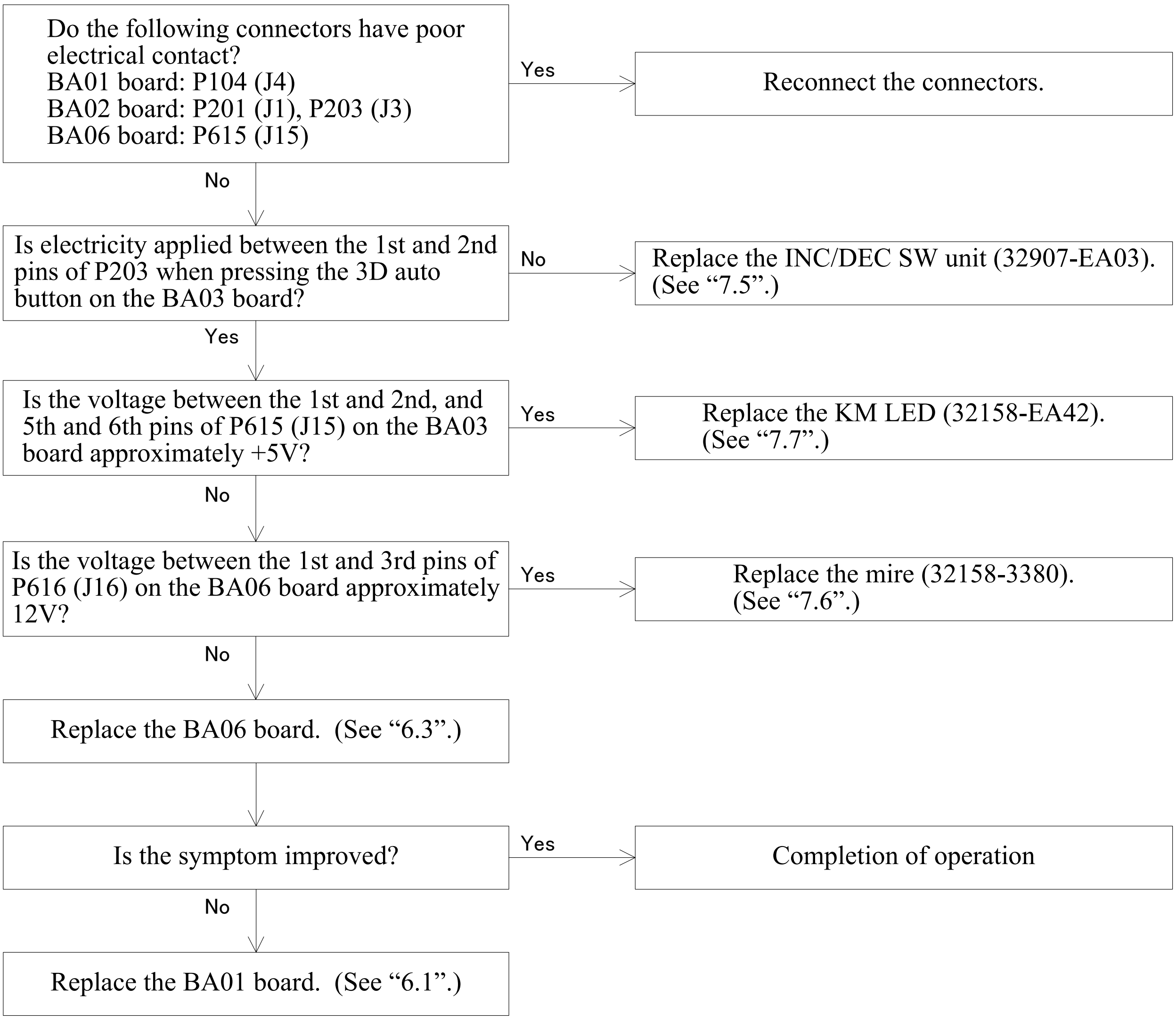
↓

Is the symptom improved?

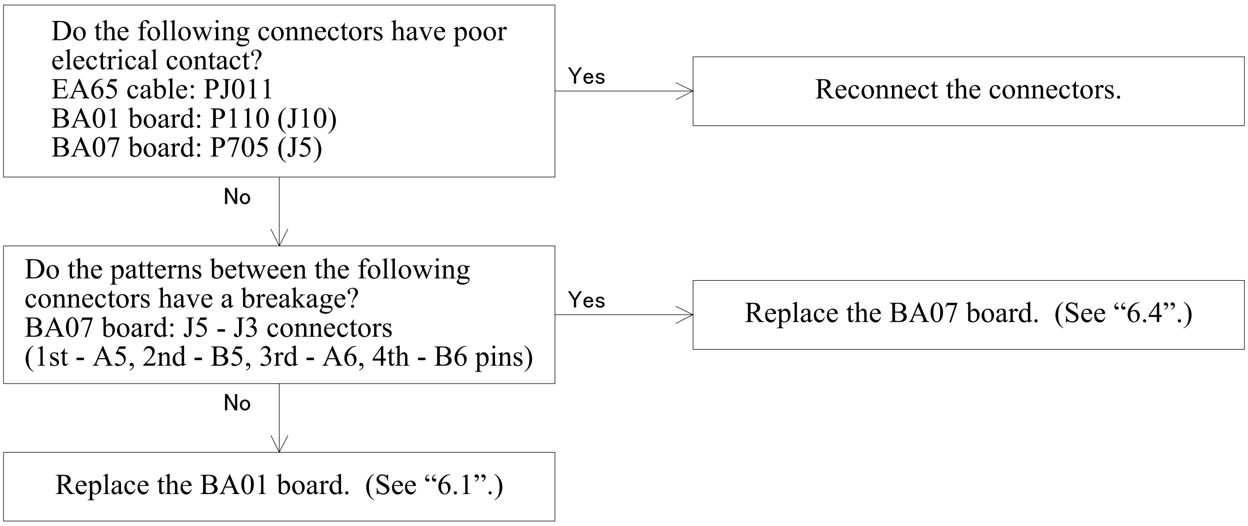
- Yes → Completion of operation
- No ↓

Replace the BA01 board. (See “6.1”.)

4.27 The auto-shot cannot be performed.



4.28 “ERR IF” appears.



NOTE

• When “Err IF” appears, set parameter No. 37 to indicate the details of the Error Code. There are 10 error codes as below. The “Err” message and the details are described below. Refer to the details of the error code when some failure occurs.

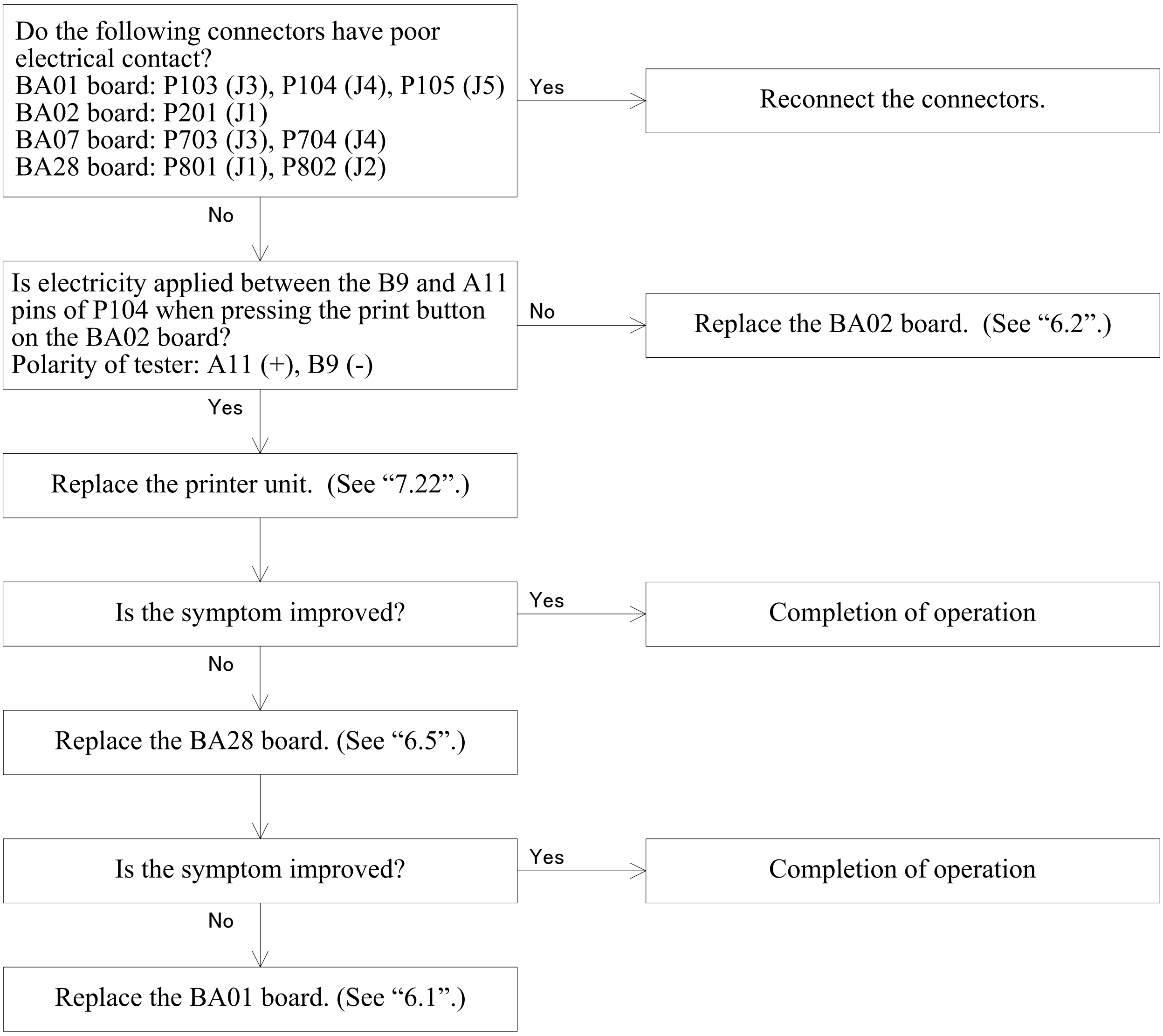
I / F CONNECTOR communication Err

Err 11: DSR is not set when SD command is received.
Err 12: DSR is not set when the data is transmitted.
Err 13: Data is not received.
Err 14: Reception buffer is full.
Err 15: Indecipherable command is received.

LM communication Err

Err 18: DSR is not set when SD command is received.
Err 19: DSR is not set when the data is transmitted.
Err 1a: Data is not received.
Err 1b: Reception buffer is full.
Err 1c: Indecipherable command is received.

4.29 The printing cannot be done.



4.30 The print is too light. / The printout has missing characters.

Adjust the print density. (See “8.21”.)

↓

Is the symptom improved?
- Yes → Completion of operation
- No ↓

Replace the printer unit. (See “7.22”.)

↓

Is the symptom improved?
- Yes → Completion of operation
- No ↓

Replace the BA01 board. (See “6.1”.)

4.31 The eyeprint mode cannot be selected.

Do the following connectors have poor electrical contact?
BA01 board: P104 (J4)
BA02: P201 (J1)

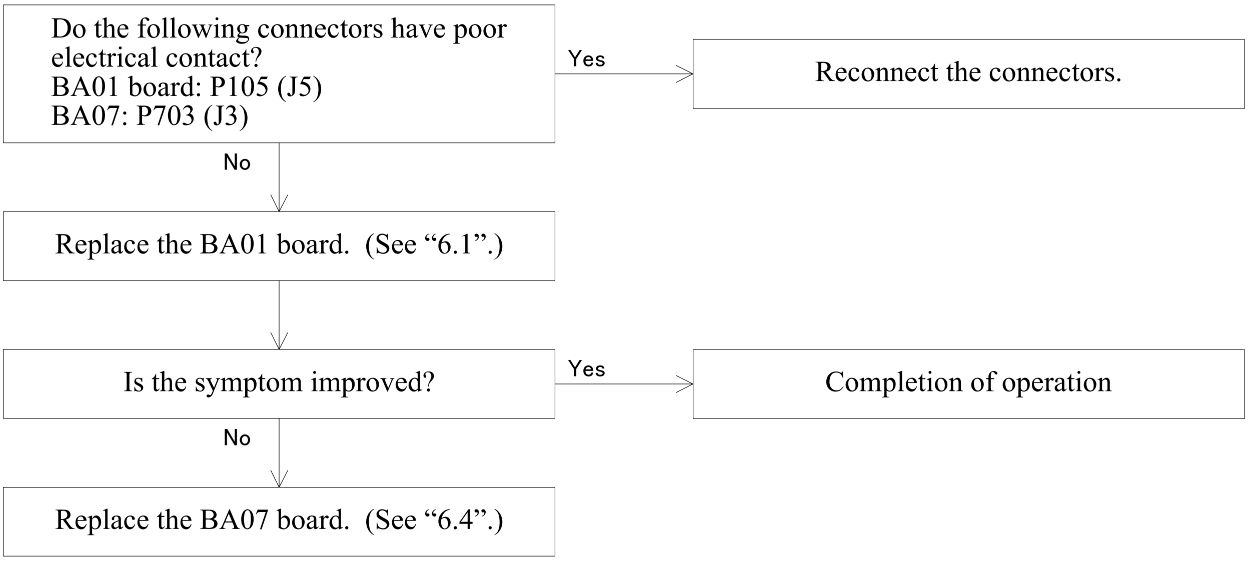
- Yes ↓

Is electricity applied between the A10 and A11 pins of P104 when pressing the eyeprint button?
* Polarity of tester: B11 (+), A10 (-)

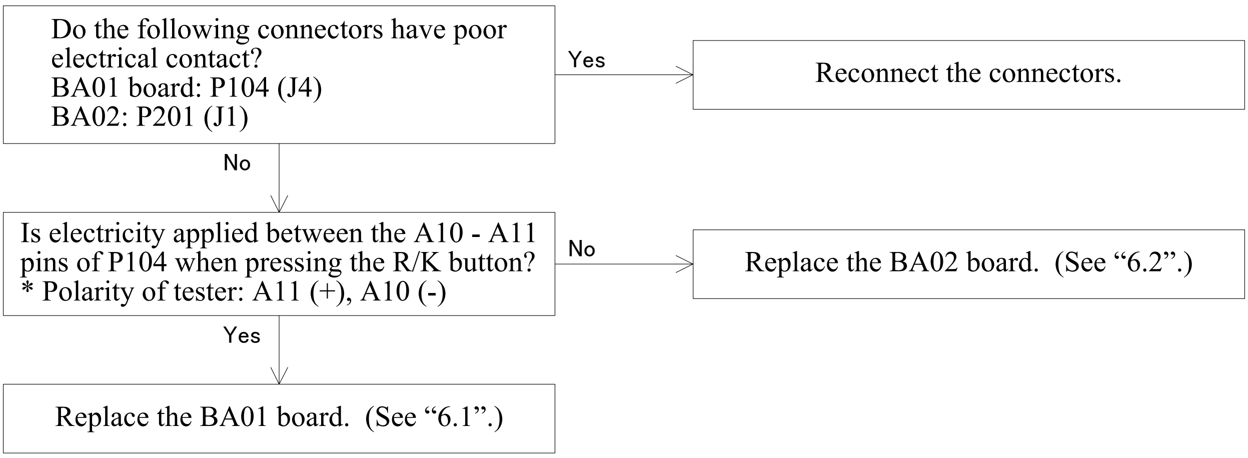
- No → Replace the BA02 board. (See “6.2”.)
- Yes ↓

Replace the BA01 board. (See “6.1”.)

4.32 The auto-off mode cannot be activated.



4.33 Switching of the R/K measurement mode cannot be done.



4.34 “Err” appears during the KM measurement.

- Do the following connectors have poor electrical contact? BA06 board: P616 (J16), P615 (J15)
  - Yes → Reconnect the connectors.
  - No ↓
- Is the voltage applied between the 3rd - 4th and 5th - 6th pins of the P615 (J15) connector on the BA06 board approximately +5V?
  - Yes → Repair the KM LED (32906-EA42) or replace it with a new one. (See “7.7”.)
  - No ↓
- Does the PC1 - PC6 cable (32906-EA64) have a breakage?
  - Yes → Repair the PC1 - PC6 cable (32906-EA64) or replace it with a new one. (See “9.2”.)
  - No ↓
- Is voltage applied to the P616 (J16) and P615 (J15) connectors on the BA06 board?
  - Yes → Replace the BA06 board. (See “6.3”.)
  - No ↓
- Replace the BA01 board. (See “6.1”.)

4.35 The data obtained by the KM measurement is abnormal.

- Perform the KM auto-calibration. (See “8.27".)
  ↓
- Is the symptom improved?
  - Yes → Completion of operation
  - No ↓
- Replace the BA22 board. (See “6.1”.)
  ↓
- Is the symptom improved?
  - Yes → Completion of operation
  - No ↓
- Replace the measuring unit. (See “7.16”.)

§5 *REMOVING COVERS*

5.1 Removing the front, left and right covers

See “5.1” of the AR-630A Service Manual.

5.2 Removing the rear cover of the measuring unit

See “5.2” of the AR-630A Service Manual.

5.3 Removing the inner cover

See “5.3” of the AR-630A Service Manual.

5.4 Removing the rear cover

See “5.4” of the AR-630A Service Manual.

5.5 Removing the TV panel

See “5.5” of the AR-630A Service Manual.

5.6 Replacing the bottom plate

See “5.6” of the AR-630A Service Manual.

§6 REPLACING THE BOARDS

6.1 Replacing the BA01 and BA22 boards

Replacement parts: 32906-BA01
Replacement parts: 32909-BA22
See "6.1" of the AR-630A Service Manual.

6.2 Replacing the BA02 board



Replacement parts: 32906-BA02
See "6.2" of the AR-630A Service Manual.
* The layout of the buttons for the ARK-730A is shown in the right figure.

6.3 Replacing the BA06 board

Replacement parts: 32906-BA06
See "6.3" of the AR-630A Service Manual.

6.4 Replacing the BA07 board

Replacement parts: 32906-BA07
See "6.4" of the AR-630A Service Manual.

6.5 Replacing the BA28 board

Replacement parts: 32906-BA28
See "6.5" of the AR-630A Service Manual.

6.6 Replacing the BA23 board

Replacement parts: 32906-BA23
See "6.6" of the AR-630A Service Manual.

§7 REPLACING THE PARTS

7.1 Replacing the transformer

Replacement parts: 32903-E003A (100V series)
Replacement parts: 32903-E003B (200V series)
See "7.1" of the AR-630A Service Manual.

7.2 Replacing the joystick

Replacement parts: 32906-2080
See "7.2" of the AR-630A Service Manual.

7.3 Replacing and cleaning the slide plate

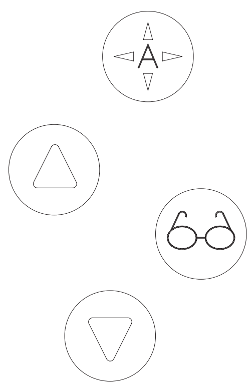
Replacement parts: 32906-M004
See "7.3" of the AR-630A Service Manual.

7.4 Replacing the PD LED unit and cleaning the IR filter

Replacement parts: 32906-EA24
See "7.4" of the AR-630A Service Manual.

7.5 Replacing the INC/DEC SW unit

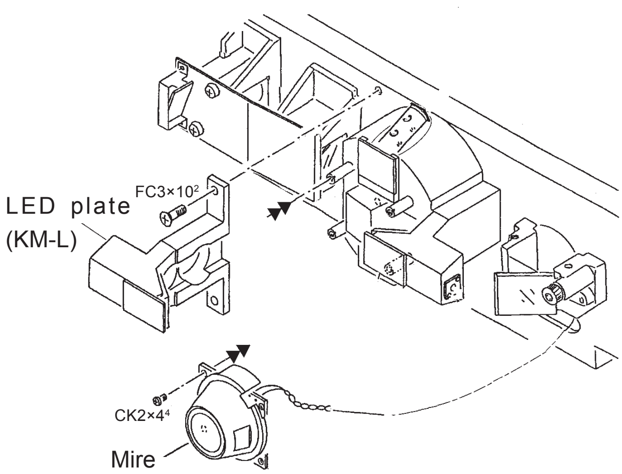
Replacement parts: 32907-EA03
See "7.5" of the AR-630A Service Manual.
* The layout of the buttons for the ARK-730A is shown in the right figure.



7.6 Replacing the mire

Replacement parts: 32163-3380

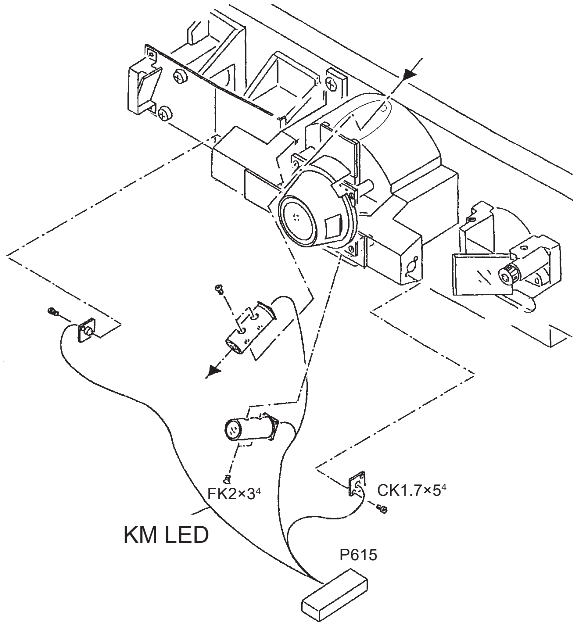
1. **Remove the left, right and front covers. (See "5.1" of the AR-630A Service Manual.)**
2. **Unscrew FC3×10 (n=2) and remove the LED plate (KM-L).**
3. **Unscrew CK2×5 (n=4) and remove the mire.**
4. **Fit the parts in reverse order.**
   * Arrange the cables so as not to interfere with the optical parts.
5. **Perform the auto-tracking and auto-shot calibration.**



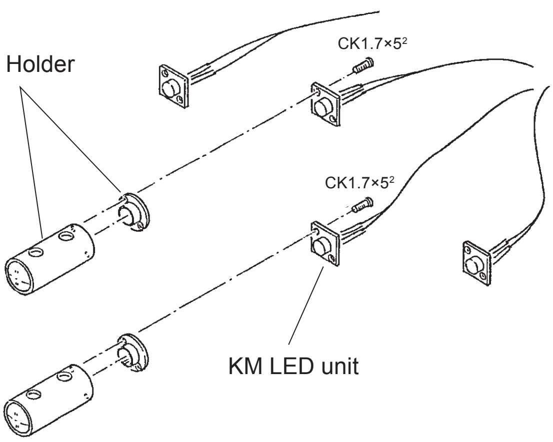
7.7 Replacing the KM LED unit

Replacement parts: 32158-EA42

1. **Remove the left, right and front covers. (See "5.1" of the AR-630A Service Manual.)**
2. **Unscrew CK1.7×5 (n=4) and FK2×4 (n=4) and remove the KM LED.**



3. **Unscrew CK1.7×5 (n=4) and remove the KM LED unit.**
4. **Fit the parts in reverse order.**
5. **Perform the auto-tracking and auto-shot calibration.**
6. **For the layout of LED, see 32163-EA42 in "9.2".**



7.8 Replacing the target origin unit

Replacement parts: 32906-EA36
See “7.8” of the AR-630A Service Manual.

7.9 Replacing the CCD camera

Replacement parts: 32903-E001A
See “7.9” of the AR-630A Service Manual.

7.10 Replacing the wheel guide ASSY

Replacement parts: 32903-M5003
See “7.10” of the AR-630A Service Manual.

7.11 Replacing the pinion

Replacement parts: 32903-M138
See “7.11” of the AR-630A Service Manual.

7.12 Replacing the shaft

Replacement parts: 32903-M5003
See “7.12” of the AR-630A Service Manual.

7.13 Replacing the bearing

Replacement parts: 82011-0410A
See “7.13” of the AR-630A Service Manual.

7.14 Replacing the U/D MOTOR unit

Replacement parts: 32906-EA46
See “7.14” of the AR-630A Service Manual.

7.15 Replacing the U/D LIMIT unit

Replacement parts: 32907-EA47
See “7.15” of the AR-630A Service Manual.

7.16 Replacing the measuring unit

Replacement parts: 32163-3000 (3100)
See “7.16” of the AR-630A Service Manual.

7.17 Replacing the TV monitor

Replacement parts: 32903-E001B

See "7.17" of the AR-630A Service Manual.

7.18 Replacing the LED

Replacement parts: 32906-3110 (for NIDEK INC.: 32159-3110)

See "7.18" of the AR-630A Service Manual.

7.19 Replacing the chart LED lamp unit

Replacement parts: 32906-EA15

See "7.19" of the AR-630A Service Manual.

7.20 Replacing the F/B MOTOR unit

Replacement parts: 32909-EA80

See "7.20" of the AR-630A Service Manual.

7.21 Relacing the R/L MOTOR unit

Replacement parts: 32909-EA48

See "7.21" of the AR-630A Service Manual.

7.22 Replacing the printer unit

Replacement parts: 34495-E002

See "6.5" of the AR-630A Service Manual.

7.23 Replacing the TRC LIMIT unit

Replacement parts: 32909-EA81

See "7.23" of the AR-630A Service Manual.

7.24 Replacing the ILLUMI LED unit

Replacement parts: 32909-6200

See "7.24" of the AR-630A Service Manual.

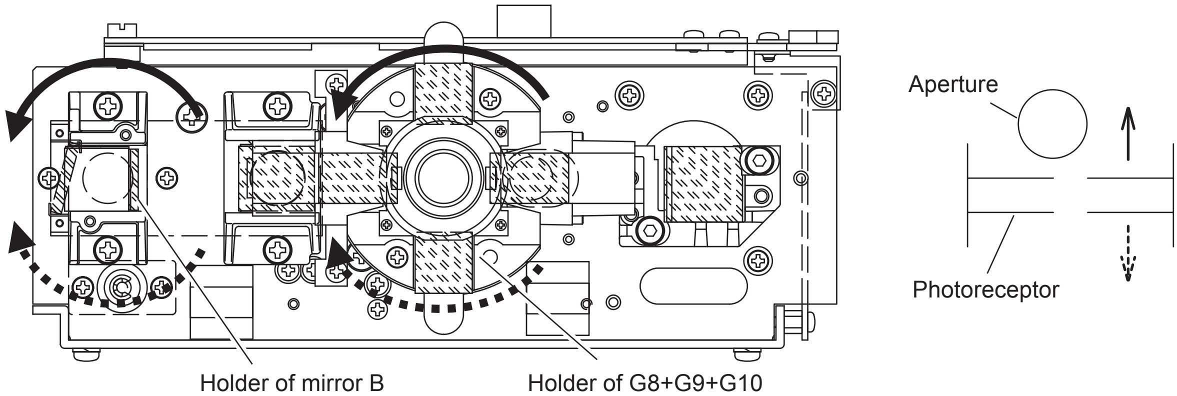
8.1 Optical axis adjustment of phototransmitter/ photoreceptor

8.1.1 Optical axis check of phototransmitter/photoreceptor

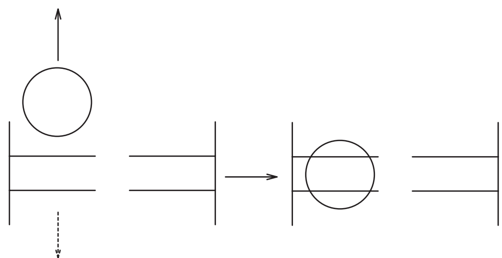
See "8.1.1" of the AR-630A Service Manual.

8.1.2 Optical axis adjustment of phototransmitter/photoreceptor

1. Turn the holder of mirror B (1589) to align the photoreceptor height at the -12D position with the aperture. (See the figure on page 8-2 for the -12D position)



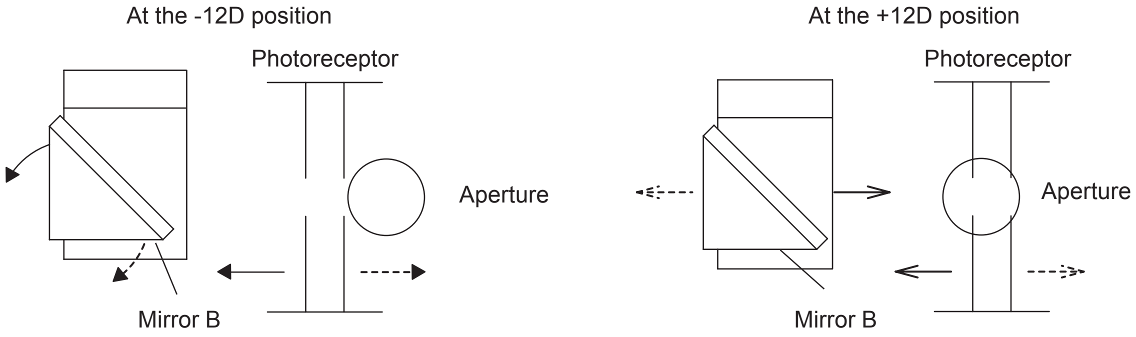
2. Turn the holder of G8+G9+G10 to align the photoreceptor height at the +12D position with the aperture center.



3. Turn the SPD holder 90º to make the photoreceptor vertical.

4. Move mirror B (1589) to make horizontal alignment of the photoreceptor at the +12D and -12D positions with the aperture.

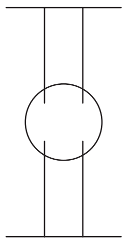
* Turn mirror B (1589) at the -12D position, and move parallel at the +12Dposition.



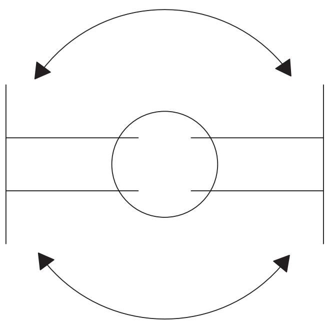
(1) Tighten the set screws (n=3) on top of the mirror B (1589) holder evenly, paying attention to the displacement in the horizontal direction.

(2) If there is displacement in the vertical direction, make adjustment by turning the mirror B (1589) holder again.

(3) Mirror B (1589) is not out of the holder.



5. Turn the SPD holder and make sure that the photoreceptor is always at the aperture center.



8.2 Optical axis adjustment of chart

8.2.1 Optical axis check of chart

1. Put a piece of white paper in front of the measuring LED.

2. Attach the optical axis adjustment jig (ARMJ-7).

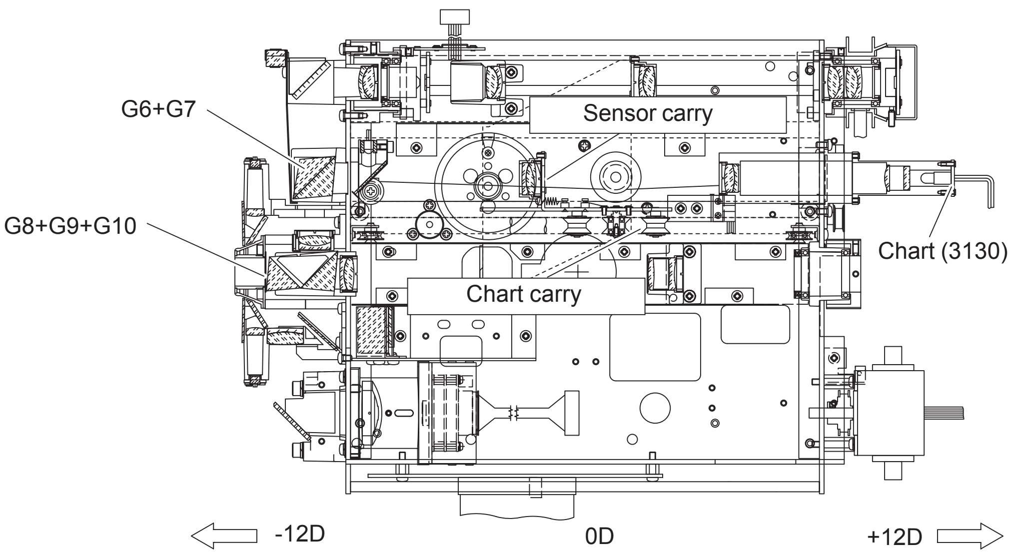
3. Set DIP switch No. 4 to the ON position and turn the system ON.

4. Press R/K (R/K button).

5. Look into G8+G9+G10 through the -12D magnifier and move the sensor carry and chart carry until the chart is focused.

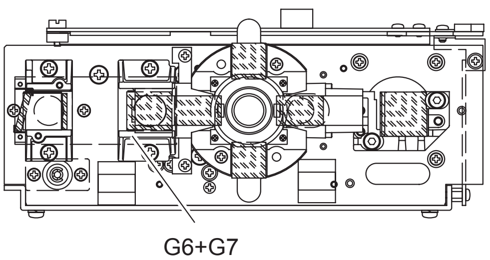
REFERENCE

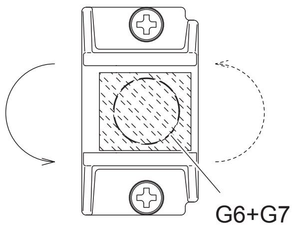
- Where both chart and aperture of the sensor carry are focused, looking into G8+G9+G10 with the naked eye ⟶ 0D position
- Where both the chart and aperture of the sensor carry are focused, looking into G8+G9+G10 with the +12D magnifier ⟶ -12D position
- Where both the chart and aperture of the sensor carry are focused, looking into G8+G9+G10 with the -12D magnifier ⟶ +12D position

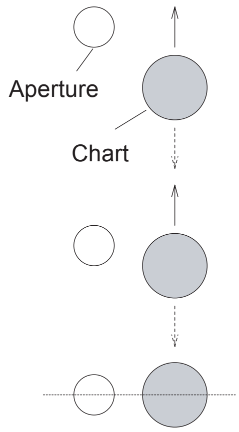


8.2.2 Adjustment of chart in vertical direction

1. Turn the holder of G6+G7 to align the chart height at the +12D and -12D positions with the aperture center.
* Check at the 0D position as well.







8.2.3 Adjustment of chart in horizontal direction

See “8.2.3” of the AR-630A Service Manual.

8.3 Three-point relationship among SPD, mask and LED

8.3.1 Check of the three-point relationship among SPD, mask and LED

See “8.3.1” of the AR-630A Service Manual.

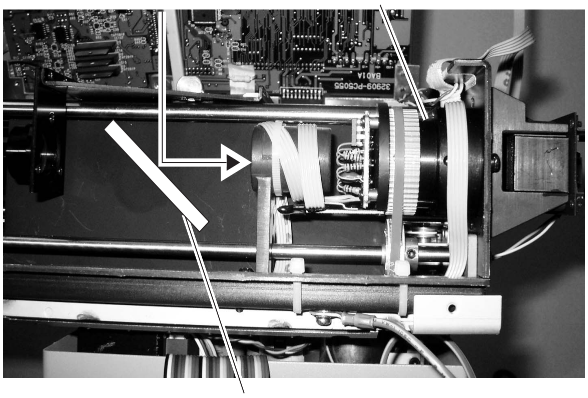
8.3.2 Perpendicular adjustment of the SPD and mask photoreceptor

See “8.3.2” of the AR-630A Service Manual.

8.3.3 Tilt adjustment of LED lights and mask photoreceptor

1. Set DIP switches No. 4 and No. 5 on the BA01 board to the ON position.

Mask unit



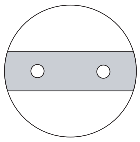
Put a piece of white paper here.

2. Turn the power switch ON and press (R/K button) .
Press the Start button on the joystick to place the system in "Test mode 1".

3. Put a piece of white paper between the sensor carry (5035) and relay lens (5043).
* The paper must be tilted so that reflected light will come into the mask unit.
* The white paper makes it easy to see the mask photoreceptor.
* This adjustment can be made by attaching the chart LED lamp (EA15) to the relay lens (5043).

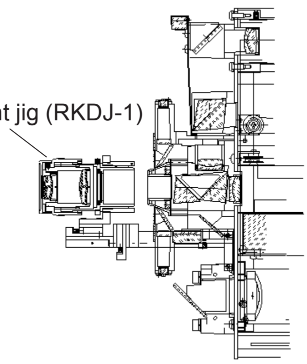
4. Draw out the + power magnifier of the optical axis adjustment jig (ARMJ-7) about 10 cm and look into G8+G9+G10. Check the positions of the LED lights and mask photoreceptor.
* As the position where one can see varies according to individual eyesight, find the appropriate position where you are able to see.

5. After the perpendicular adjustment of the SPD and mask photoreceptor is completed, attach the LED adjustment jig (RKDJ-1) as the right figure shows. Verify that the LED lights are parallel to the mask photoreceptor.
* When the LED adjustment jig (RKDJ-1) is available, use the LED adjustment jig (RKDJ-1) instead of the optical adjustment jig (ARMJ-7) for this adjustment.
* If the LED lights are not parallel to the mask photoreceptor, follow steps 6 - 7 to perform the tilt adjustment of the LED light and mask photoreceptor.



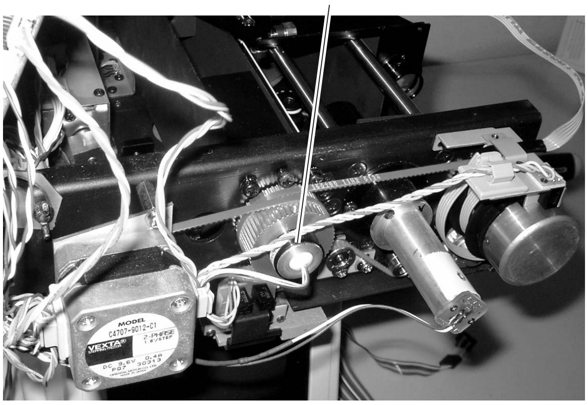
The LED lights are parallel to the mask photoreceptor.

LED adjustment jig (RKDJ-1)

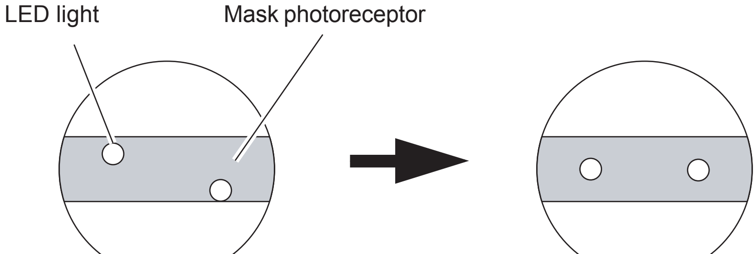


6. Loosen HH3×4 (n=2) retaining the LED (3110).

* It makes the SPD and LED turn separately, and only the LED light turns.



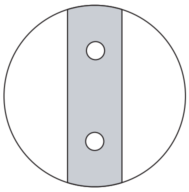
7. Look into G8+G9+G10 with the + power magnifier of the optical adjustment jig (ARMJ-7) and turn the LED until the LED lights are parallel to the mask photoreceptor.



The LED lights are not parallel to the mask photoreceptor.

The LED lights are parallel to the mask photoreceptor.

8. Loosen HH3×4 (n=2) retaining the LED.
When the LED lights have become parallel to the mask photoreceptor, make sure that the LED lights are positioned in the middle of the mask photoreceptor as the right figure shows.
If not, perform "8.3.4 LED adjustment in the middle".



The LED lights are positioned in the middle of the mask photoreceptor.

8.3.4 LED adjustment in the middle

See "8.3.4" of the AR-630A Service Manual.

8.3.5 Check after adjustment of three-point relationship among SPD, mask and LED

See "8.3.5" of the AR-630A Service Manual.

8.4 Position adjustment of target and LED lights

See "8.4" of the AR-630A Service Manual.

8.5 CYL value adjustment

See "8.5" of the AR-630A Service Manual.

8.5.1 When the height of the side-by-side waveforms is different

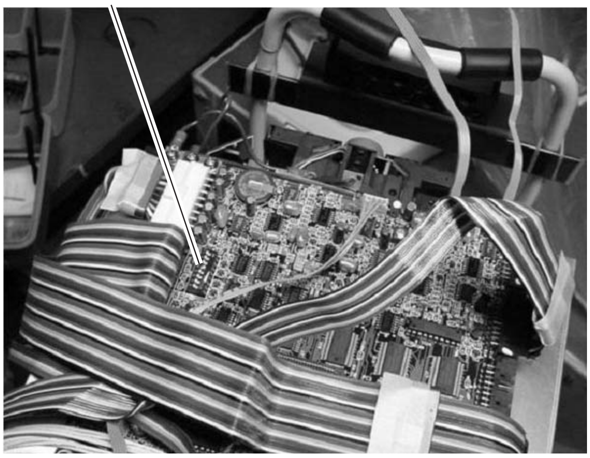
1. Set DIP switches No. 4 to the ON position and No. 5 to the OFF position, and press (IOL button).

2. Align the system with the -10D model eye.

3. Press the START button on the joystick twice to establish "Test mode 2".

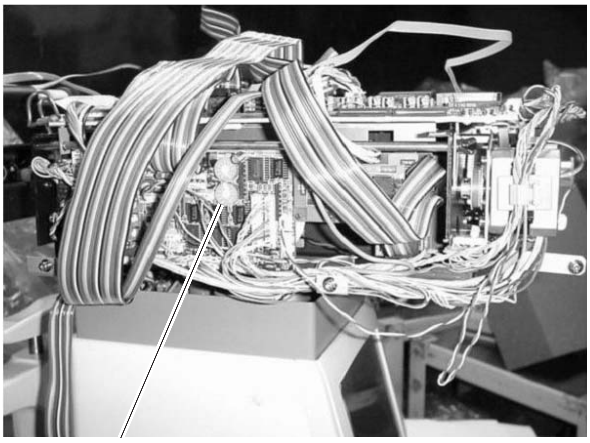
4. Set the SPD unit (5047) to the 90º position (left side).

DIP switch on the BA01 board



5. Adjust VR3 or VR4 on the BA06 board so that the side-by-side waveforms will become the same height on the oscilloscope display signal.

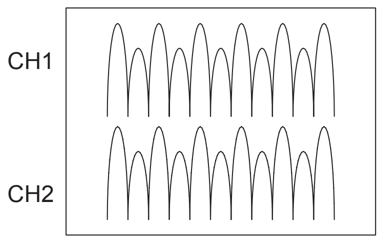
* With both VR3 and VR4 fully turned counterclockwise, adjust the light quantity to low.



VR3 and VR4 on the BA06 board

6. When the height of the side-by-side waveforms becomes the same, make sure that the waveforms between CH1 and CH2 are equal in amplitude.

7. If not, perform "8.5.2 Optical axis adjustment of phototransmitter/photoreceptor system in horizontal direction".



8.5.2 Optical axis adjustment of phototransmitter/photoreceptor system in horizontal direction

See “8.5.2” of the AR-630A Service Manual.

8.5.3 Optical axis adjustment of phototransmitter/photoreceptor system in vertical direction

See “8.5.3” of the AR-630A Service Manual.

8.5.4 Check after waveform adjustment

See “8.5.4” of the AR-630A Service Manual.

8.6 Measurable range adjustment

See “8.6” of the AR-630A Service Manual.

8.7 SPH value calibration

See “8.7” of the AR-630A Service Manual.

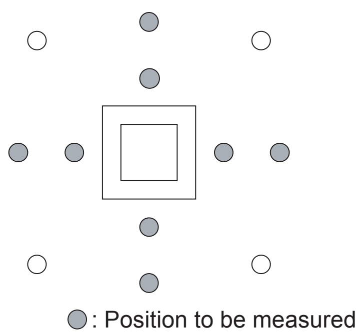
8.8 AR AXIS adjustment

See “8.8” of the AR-630A Service Manual.

8.9 IOL check

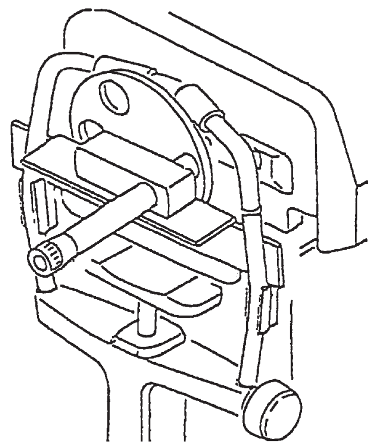
Check that the measurement can be performed in the IOL mode.

1. Attach the non-cemented model eye (RKDJ-1 0900).
2. Press (Eyeprint button).
3. Align the system with the +10D model eye and slightly defocus by pushing in the focusing direction, and make sure that an error does not occur when two spots are measured in each direction.

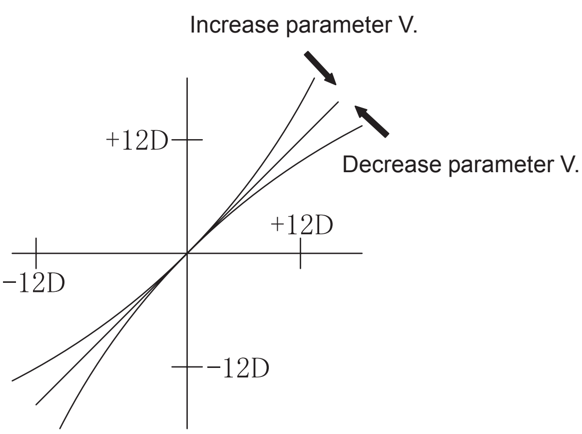


8.10 Chart calibration

1. **Adjust the visibility of the dioptric tester.**
2. **Attach the chart calibration jig (ARMJ-6) and turn its rotor plate to align with the model eye for alignment.**
3. **Set DIP switch No. 4 on the BA01 board to the ON position.**



4. **Press (Change button), then press the START button to place the system in "MODE 12-0".**
5. **Move the main body forward and backward to align with the model eye.**
6. **Set the rotor plate of the jig in the hole with nothing in it. (0D position adjustment)**
7. **Look into the dioptric tester to bring the chart in focus.**
   * Pressing (Change button) increases the value.
   * Pressing (R/K button) decreases the value.
   * Bring the chart in focus, adjusting from the + side.
8. **Press (Change button), then press the START button to establish "MODE 12-1".**
   * The button operation is the same as in "MODE 12-0".
9. **Press the START button to establish "MODE 12-2".**
10. **Turn the rotor plate of the jig to align with the +12D lens. Press (Print button) to bring the chart into focus (+12.00: +12D position adjustment)**
    * The button operation is the same as in "MODE 12-0".
    * The value when focus is achieved must be between +11.80 and +12.20. If not, establish "MODE 12-1" again and fine-adjust the value.
    * Increase the value if the absolute value is small and decrease the value if it is large.
11. **Perform the -12D position adjustment by the same procedure as step 10.**
    * The value when focus is achieved must be between -12.20 and -11.80. If not, establish "MODE 12-1" again and fine-adjust the value.
    * Increase the value if the absolute value is small and decrease the value if it is large.
12. **When the -12D or +12D position cannot be adjusted (the line does not become straight) by the above adjustment, establish "MODE 12-0" and change parameter V.**
13. **After the adjustment, remove the chart calibration jig.**



8.11 Internal reflection check

See "8.11" of the AR-630A Service Manual.

8.12 Tilt adjustment of Chart

See "8.12" of the AR-630A Service Manual.

8.13 PD adjustment

8.13.1 PD adjustment



1. **Attach the center PD check jig onto the chin rest.**
   * The scale must be parallel to the target.
   * The mark position of the scale must agree with the Eye line marker.
2. **When the main body is fixed by the knob, make sure that the center deviation is within 2 mm (3mm for test).**
   * Make this adjustment after turning the power OFF and then on again.
3. **Turn OFF the power switch.**
4. **Press (CYL Mode Change button) and (Eyeprint button) simultaneously, then turn ON the power switch.**
5. **Press the START button to establish "MODE 13-1"**
6. **Fix the main body by the knob and match the center of the scale with the one of the target. Then, move the main body from the center of the scale to the left and right evenly and press (Print button) to measure 64 mm and 80 mm.**

   Adjust the gain with ▲ (UP button) and ▼ (DOWN button) so that the shift lengths at 64 mm and 80 mm are almost the same.
7. **Press (Print button).**
8. **Press (Setting button).**
9. **Press (CYL Mode Change button) and (Eyeprint button) simultaneously.**

8.13.2 PD (64 mm and 80 mm) offset adjustment

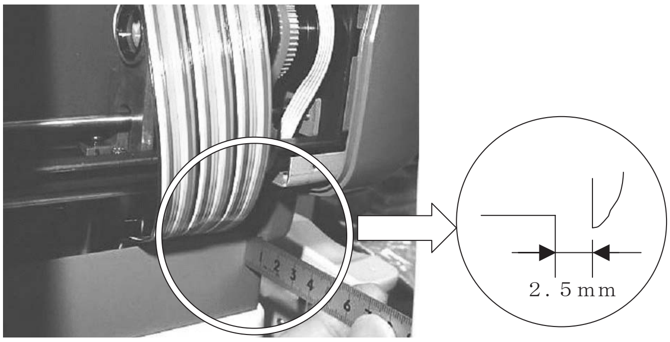
1. Press the START button to establish "MODE 13-2".
2. Adjust the offset with ▲ (UP button) and ▼ (DOWN button) until the measured value on the monitor becomes 64.0 ± 0.9 (for PD 64 mm) and 80.0 ± 1.0 (for PD 80 mm).
3. Press (Setting button).
4. Press CYL (CYL Mode Change button) and (Eyeprint button) simultaneously to save the parameter.

8.14 Auto-tracking adjustment

Perform this adjustment in the state that the front cover is attached.

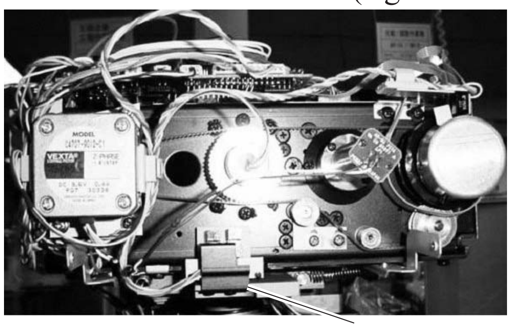
8.14.1 R/L adjustment

1. Set DIP switch No. 4 to the ON position and turn ON the power switch to establish "MODE 31-0" for adjustment.
2. Measure the clearance between the front cover and M084 with a steel scale and manipulate the joystick until the clearance becomes 2.5 mm.



3. Adjust the sensor plate (M822) to the position where the LIMIT on the TV monitor changes from 0 to 1 and fix it.
* Adjust both the right and left limits so that the LIMIT on the TV monitor changes from 0 to 1 when the clearance is 2.5 mm.
* The difference between the right and left clearances must be within 0.5 mm. (e.g. 2 mm and 2.5 mm, 2.5 mm and 3 mm)

4. Press ▲ (UP button) and ▼ (DOWN button) and make sure that the difference between the clearances is 1 mm or less when moving the measuring unit to the right LIMIT and left LIMIT.



Sensor plate

8.14.2 F/B adjustment

1. **Establish "MODE 31-1" for adjustment and press the START button once.**

2. **Measure the clearance between the front cover and M084 with a steel scale and manipulate the joystick until the clearance becomes 2 mm.**

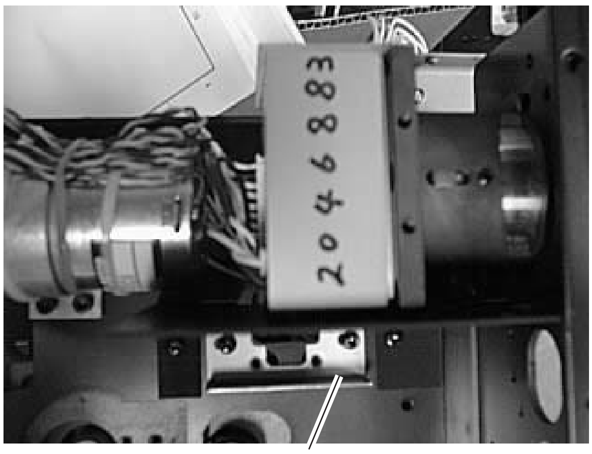


3. **Hold the front cover by hand and measure the clearance between the front cover and M084 where there is no opening between the front plate (M302) and front cover.**



4. **Fix the sensor plate (M815) where the LIMIT on the monitor changes from 0 to 1.**

5. **Press ▲ (UP button) and ▼ (DOWN button) to move the measuring unit to the limit position and make sure that the clearance between the front cover and M084 is 2 mm. (The difference must be 1 mm or less.)**



8.15 Auto-shot adjustment

See "8.15" of the AR-630A Service Manual.

8.16 Adjusting the up-and-down movement of the measuring unit

8.16.1 Adjusting the tightness of the nut stopper

See "8.16.1" of the AR-630A Service Manual.

8.16.2 Adjusting the tightness of the screws retaining the up-down bearings

See "8.16.2" of the AR-630A Service Manual.

8.16.3 Adjusting the lead screw for up-and-down movement

See "8.16.3" of the AR-630A Service Manual.

8.17 Cleaning the measuring window

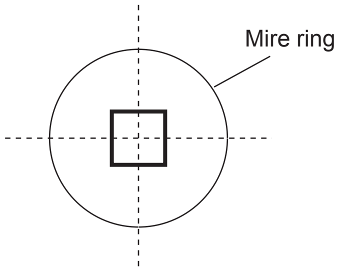
See "8.17" of the AR-630A Service Manual.

8.18 Cleaning the model eyes and steel balls

See "8.18" of the AR-630A Service Manual.

8.19 Tracking and auto-shot calibration

1. **Set DIP switch No. 4 to the ON position.**
2. **Follow the instructions below to establish "TRC ADJUST MODE".**
3. **Press the power switch while holding down (Eyeprint button) and (CYL Mode Change button).**
4. **Attach the model eye.**
5. **Press (3D Auto button) to establish "TRC ADJUST MODE 30".**
6. **Align the mire ring with the target and adjust the focus properly, then press (View Comparison button).**
   * Align the mire ring to the center of the target and visually obtain focus.



8.20 Setting the mask blink level

1. **Establish "MODE 14" and set the value to +410 (2.5V) with (Change button) and (R/K button).**

8.21 Setting print density

1. **Turn ON the power switch.**
2. **Set DIP switch No. 3 on the BA01 board to the ON position to establish "MODE 10".**
3. **Change the value with (Change button) and (R/K button) (the value changes in the -1.00 to +1.00 range in increments of 1) and print out the data with (Print button) to check the printout for density.**

<Test print pattern>

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PQRSTUVWXYZ［¥］↑↓◇ABCDEFG
HIJKLMNOPQRSTUVWXYZ（L）→
■。「」、・ヲアイウエオヤユヨツーアイウオカキ
クケコサシスセソタチツテトナニヌネノハヒヘホマ
ミムメモヤユヨラリルレロワン

NOTE

- Normally set the data to "000".
  Setting a positive value will slow down the printing speed and increase the print density.
- Do not set the value larger than necessary.
  Setting the value too large may affect the life of the printer head.

8.22 Replacing the printer unit

See "6.5 Replacing the BA28 board" of the AR-630A Service Manual.

8.23 Setting sensor offset

See "8.22" of the AR-630A Service Manual.

8.24 Sensor calibration

See "8.23" of the AR-630A Service Manual.

8.25 Setting EEPROM DATA

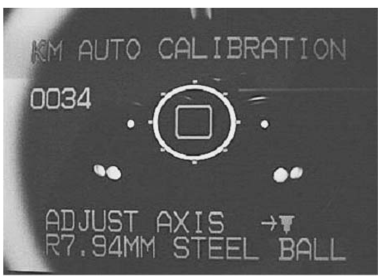
See "8.24" of the AR-630A Service Manual.

8.26 Adjusting the up-and-down movement of the chin rest

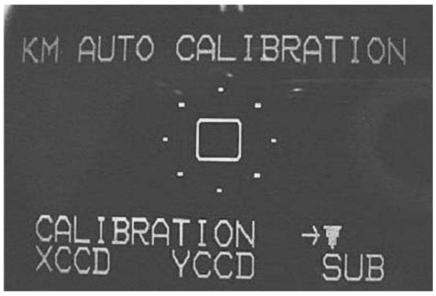
See "8.25" of the AR-630A Service Manual.

8.27 KM calibration





1. **Attach the steel ball to the chin rest.**
2. **Turn ON the power switch while holding down (Eyeprint button) and (CYL Mode Change button). "ADJUST MENU" mode is established.**
   * When the covers are removed, set DIP switch No. 4 to the ON position and turn ON the power switch to establish the "ADJUST MENU" mode.
3. **Press (R/K button) to select "KM AUTO CALIBRATION".**
4. **Press (DOWN button).**



5. Perform the calibration with the steel balls of R5.95 mm, R7.94 mm and R9.13 mm.

6. Press (Setting button) to establish "ADJUST MENU" mode.

7. Press (Eyeprint button) and (CYL Mode Change button) simultaneously to store the data obtained by the adjustment.

* When the covers are removed, set DIP switch No. 4 to the OFF position to store the data obtained by the adjustment and exit from the "ADJUSMENT MENU" mode.

8. Select the auto-tracking and measure the steel balls of R5.95 mm, R7.94 mm and R9.13 mm.

* If the measured value is out of the tolerance (nominal value ± 0.02), follow the instructions below to adjust the GAIN so that the value becomes within the tolerance.



(1) Establish "ADJUST MENU" mode as in step 2.

(2) Press (R/K button) to select "KM AUTO CALIBRATION".

(3) Press (UP button) to establish the "CORRECT" mode.

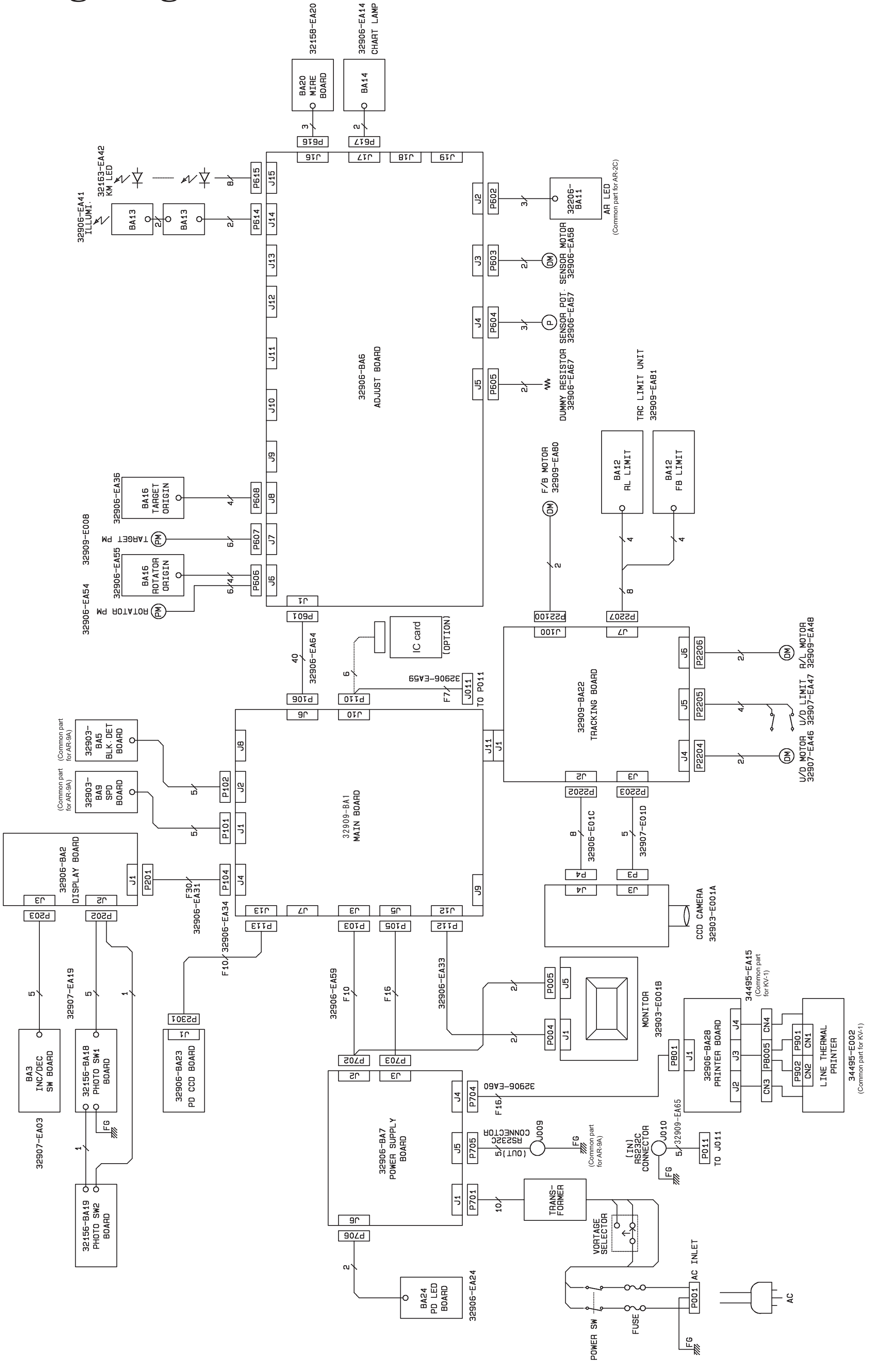
(4) For each steel ball of R5.95 mm, R7.94 mm and R9.13 mm, decrease the value if the measured value is large and increase the value if it is small.

* The last three digits of 1.0000 magnification are indicated on the monitor.
  [e.g.] When the value is "1.0200," "200" is indicated on the monitor.

(5) Press (Setting button) to establish the "ADJUST MENU" mode.

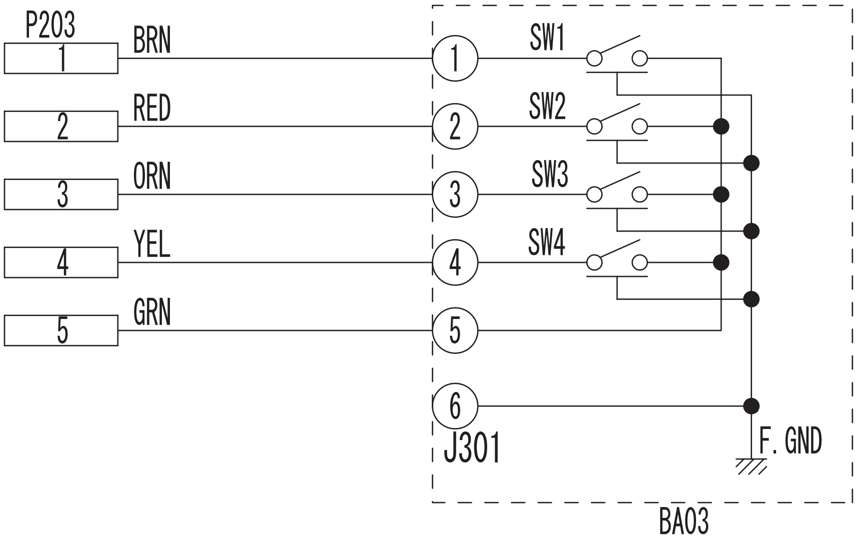
(6) Store the data obtained by the adjustment as in step 7.

9.1 Wiring Diagram

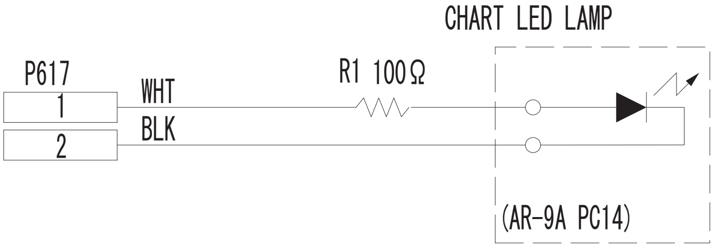


9.2 Connecting Cables

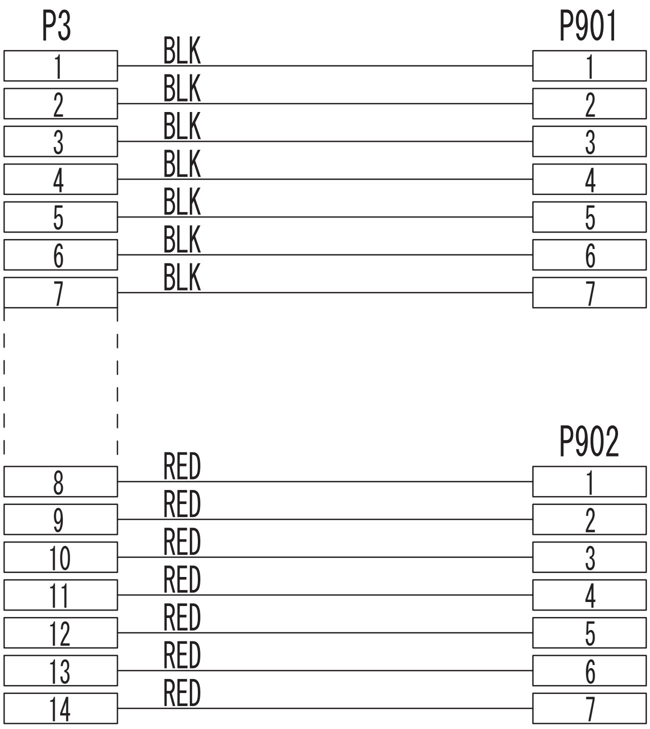
32907-EA03



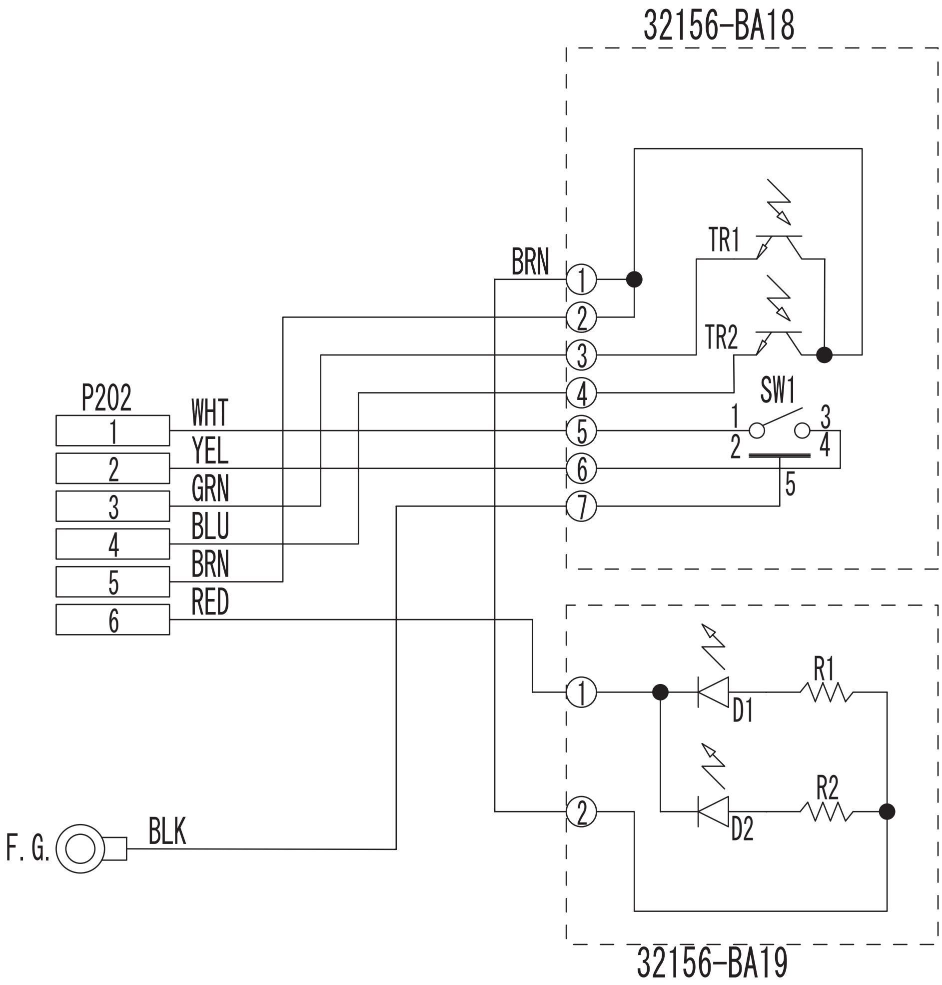
32906-EA15



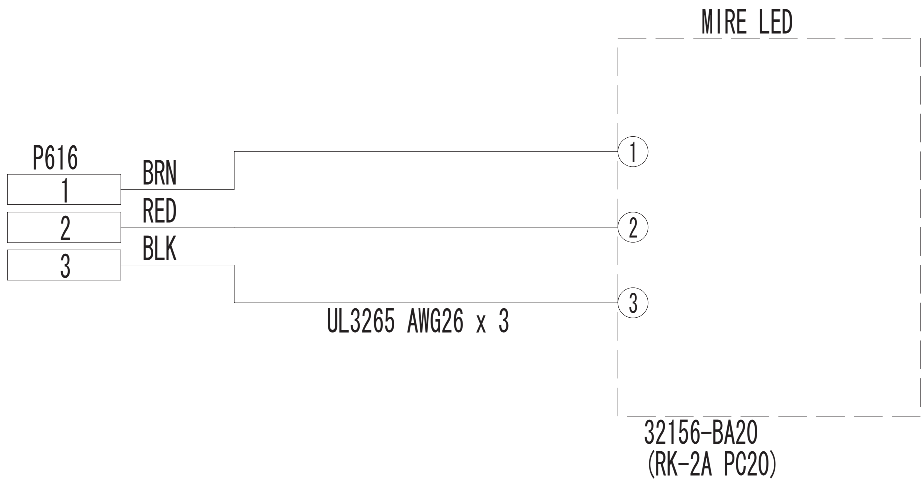
34495-EA15



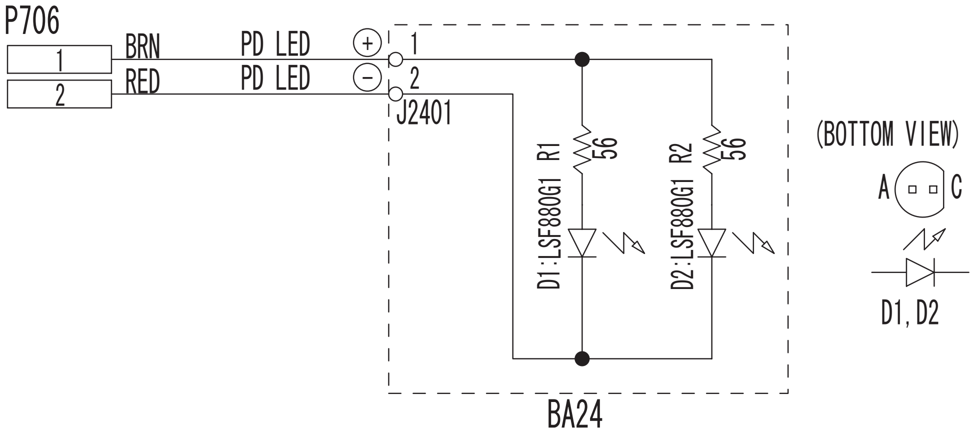
32907-EA19



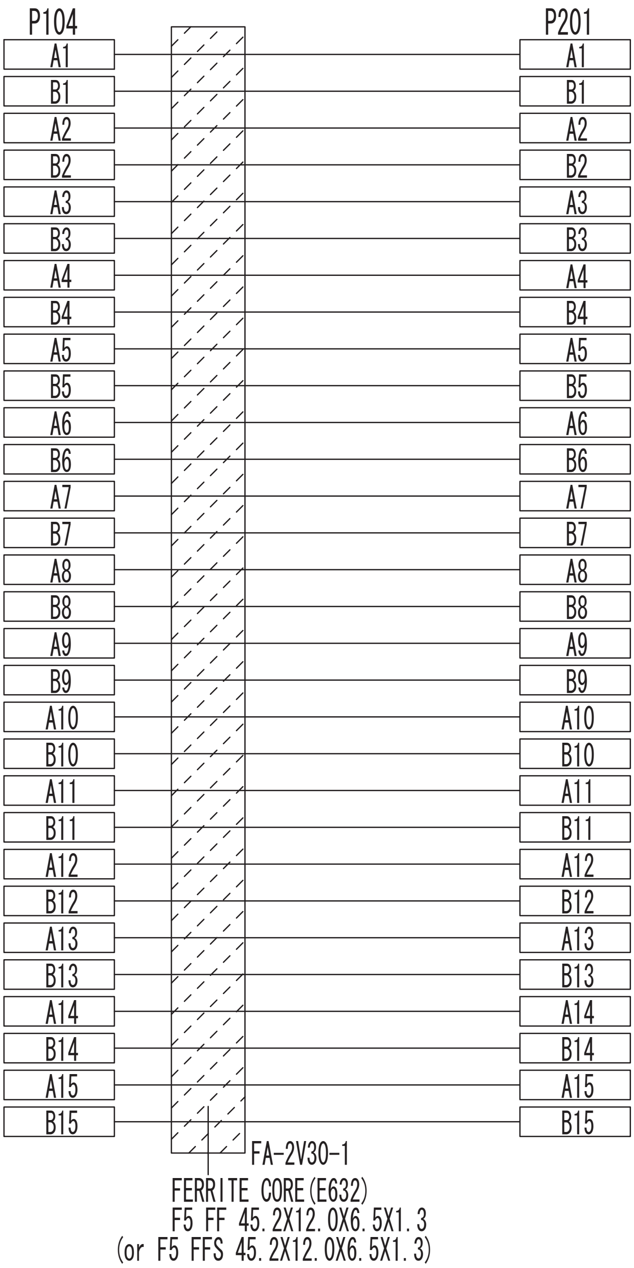
32185-EA20



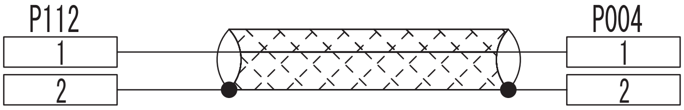
32906-EA24



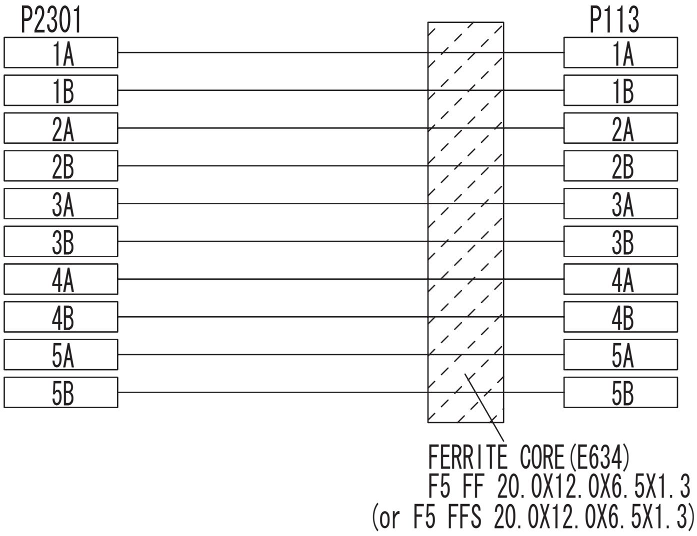
32909-EA31



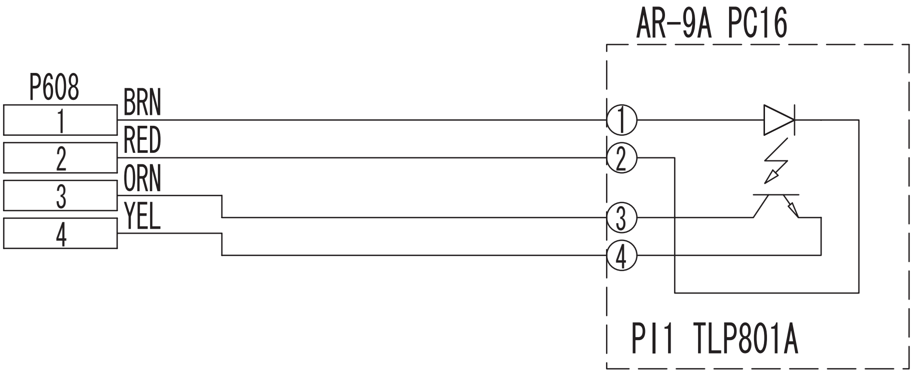
32906-EA33



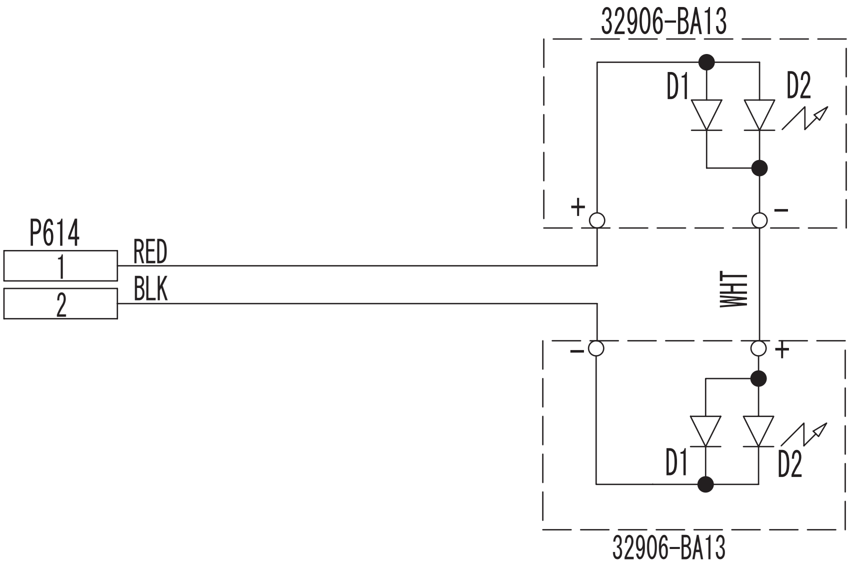
32906-EA34



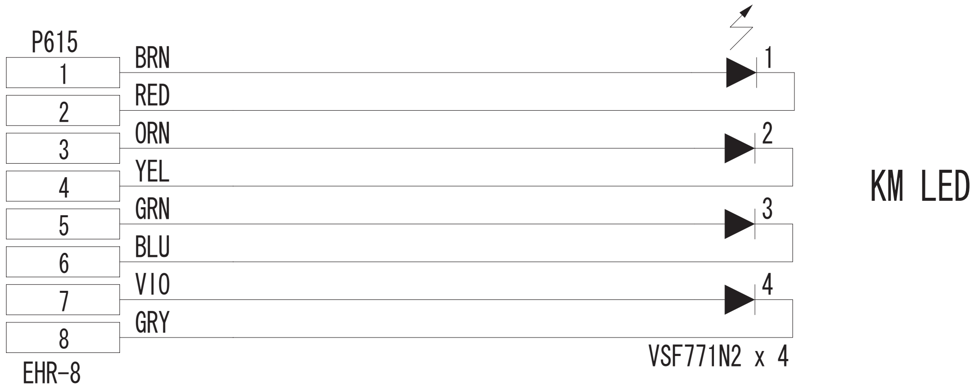
32906-EA36

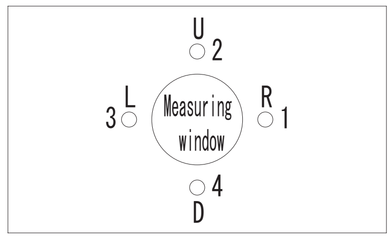


32906-EA41



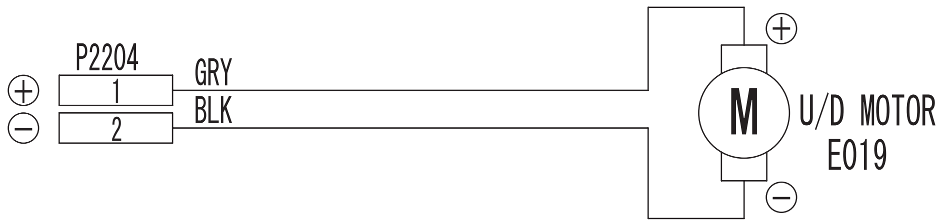
32163-EA42



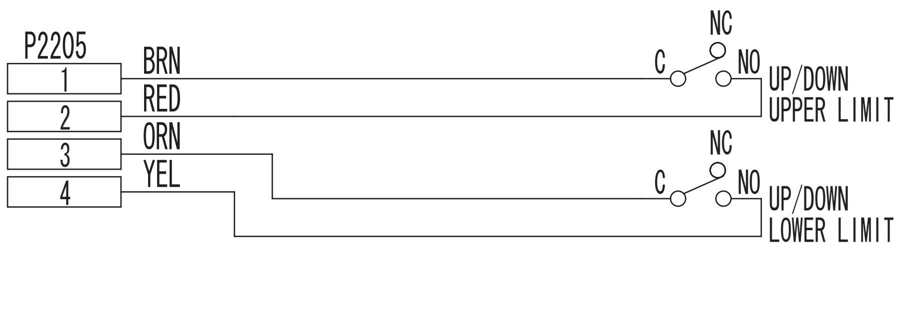


(Viewed from the patient's side)

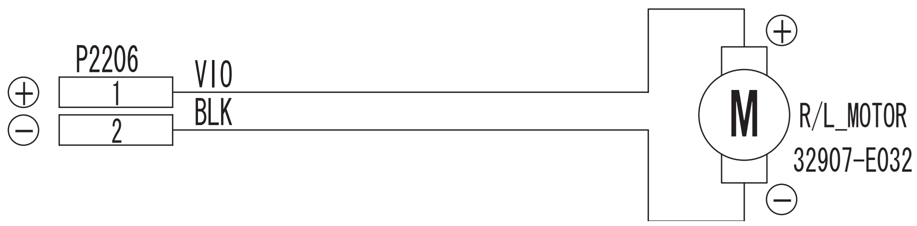
32907-EA46



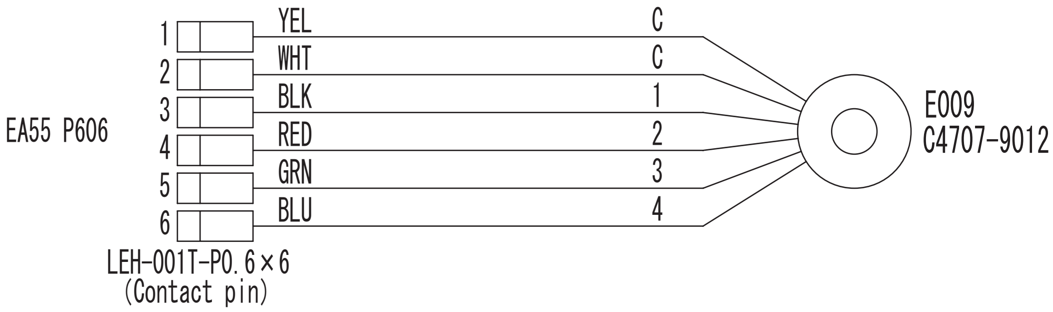
32909-EA47



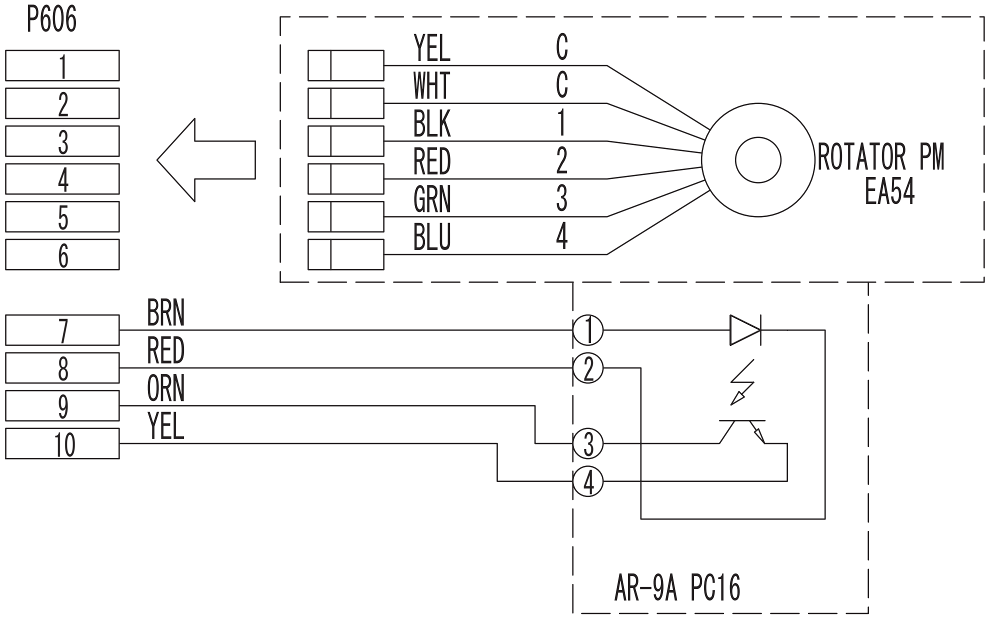
32909-EA48



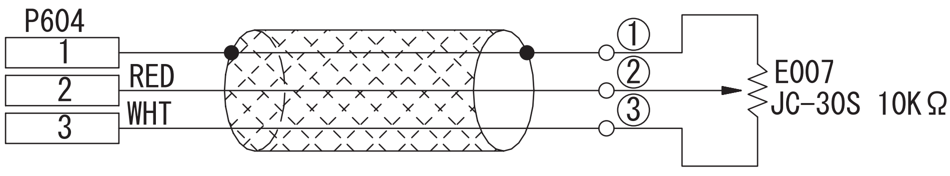
32906-EA54



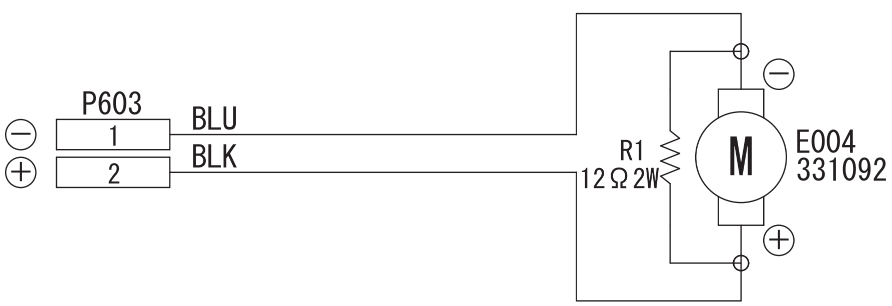
32906-EA55



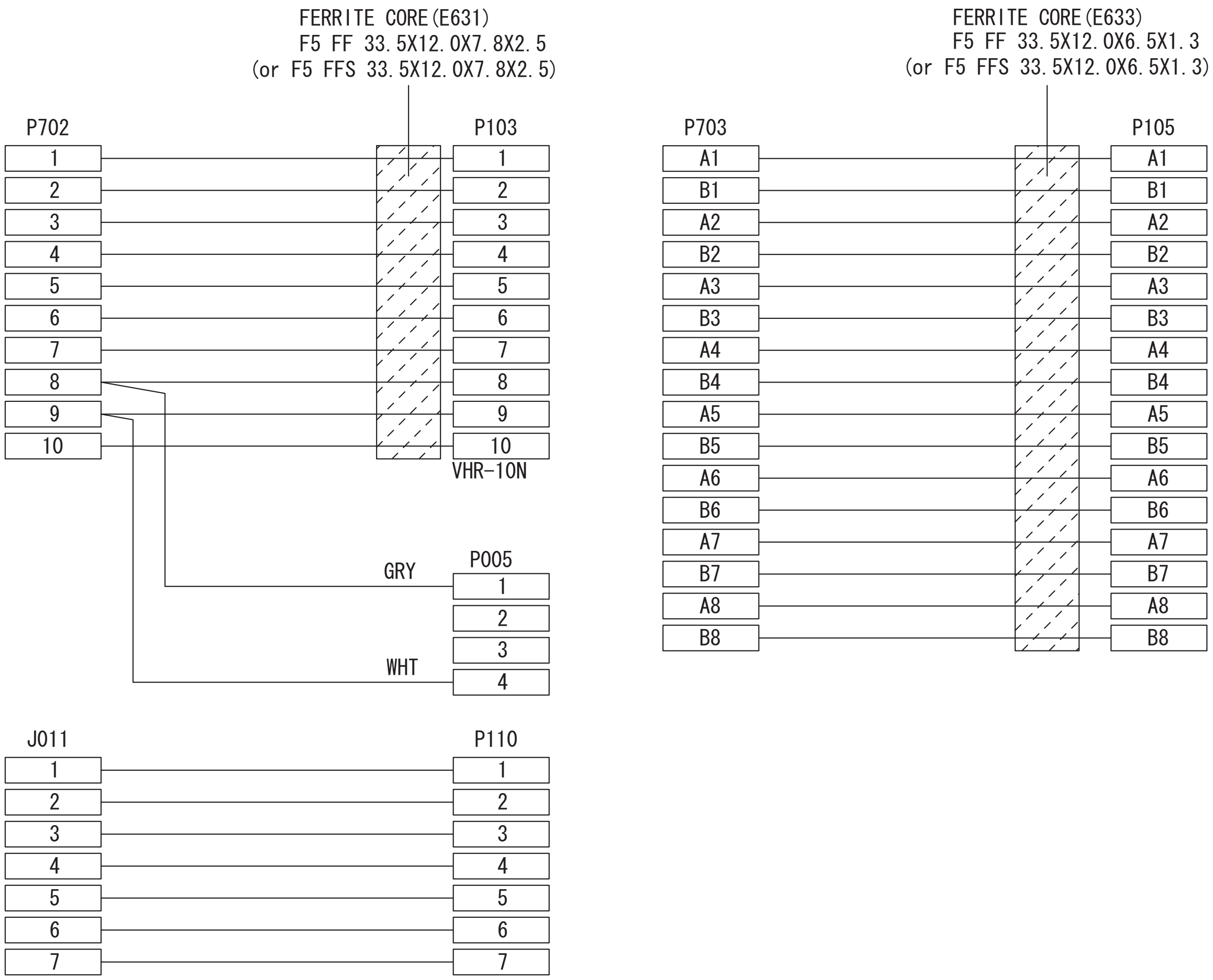
32906-EA57



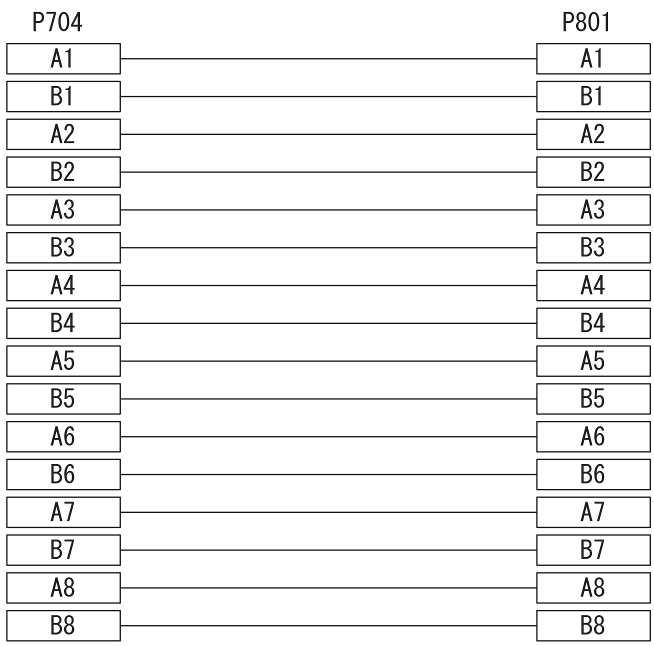
32906-EA58



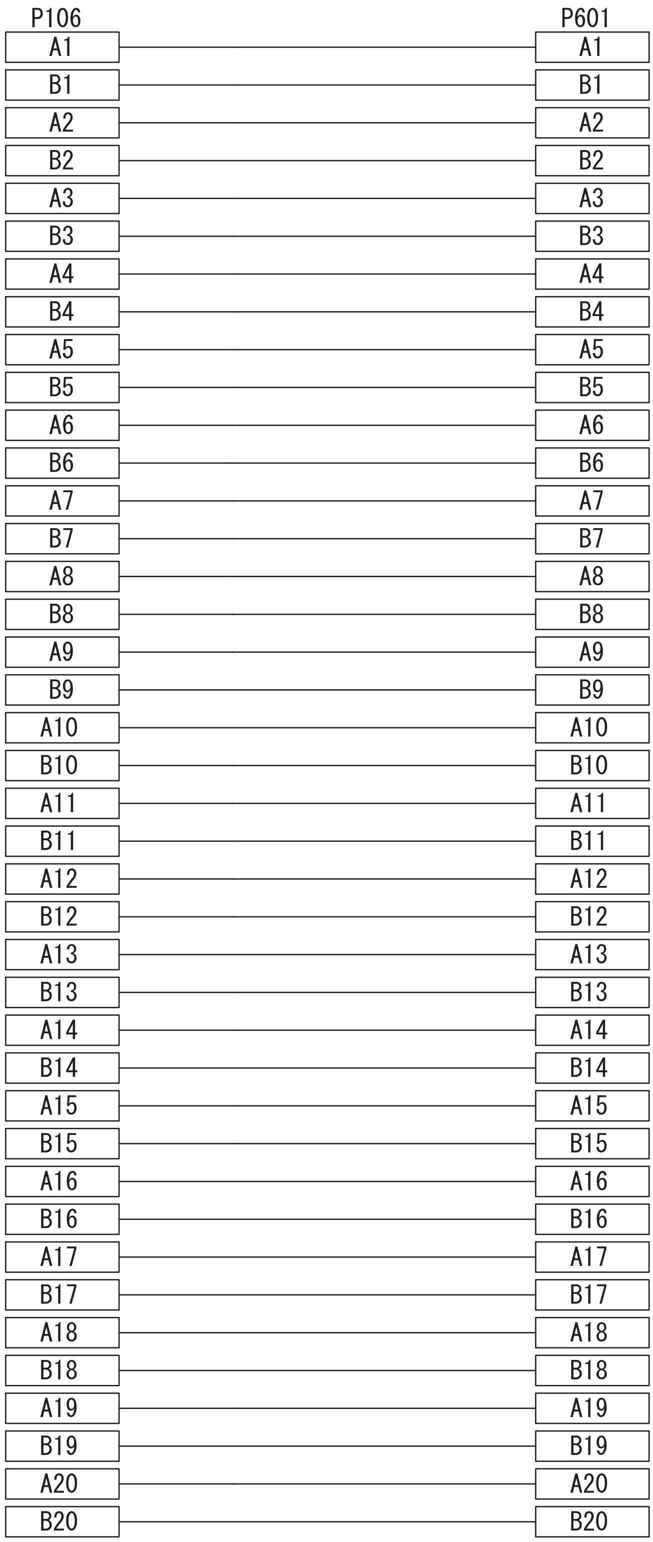
32909-EA59



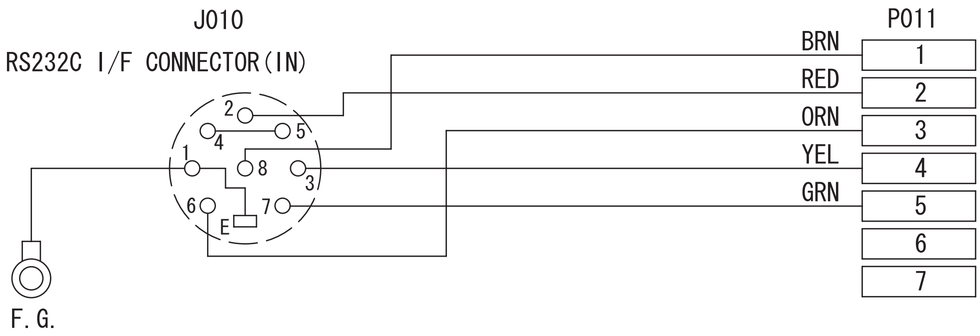
32906-EA60



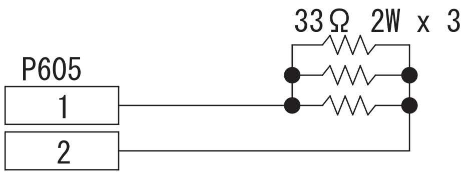
32906-EA64


P106
P601
A1
A1
B1
B1
A2
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B2
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B3
A4
A4
B4
B4
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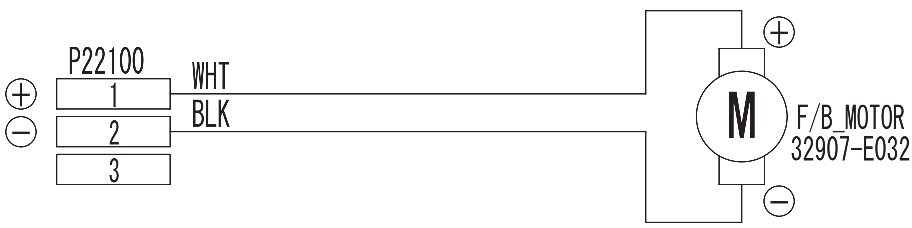
32909-EA65



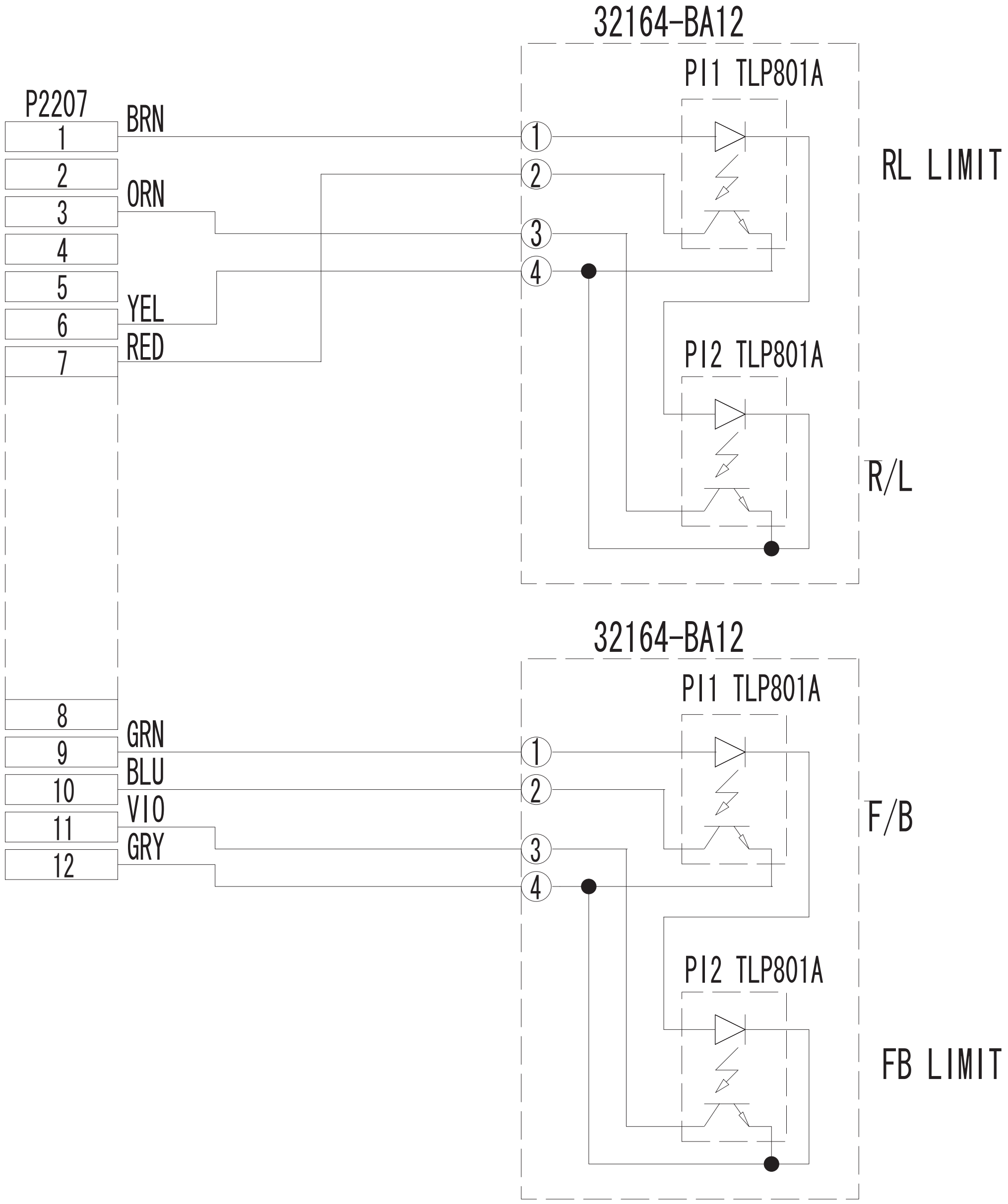
32906-EA67



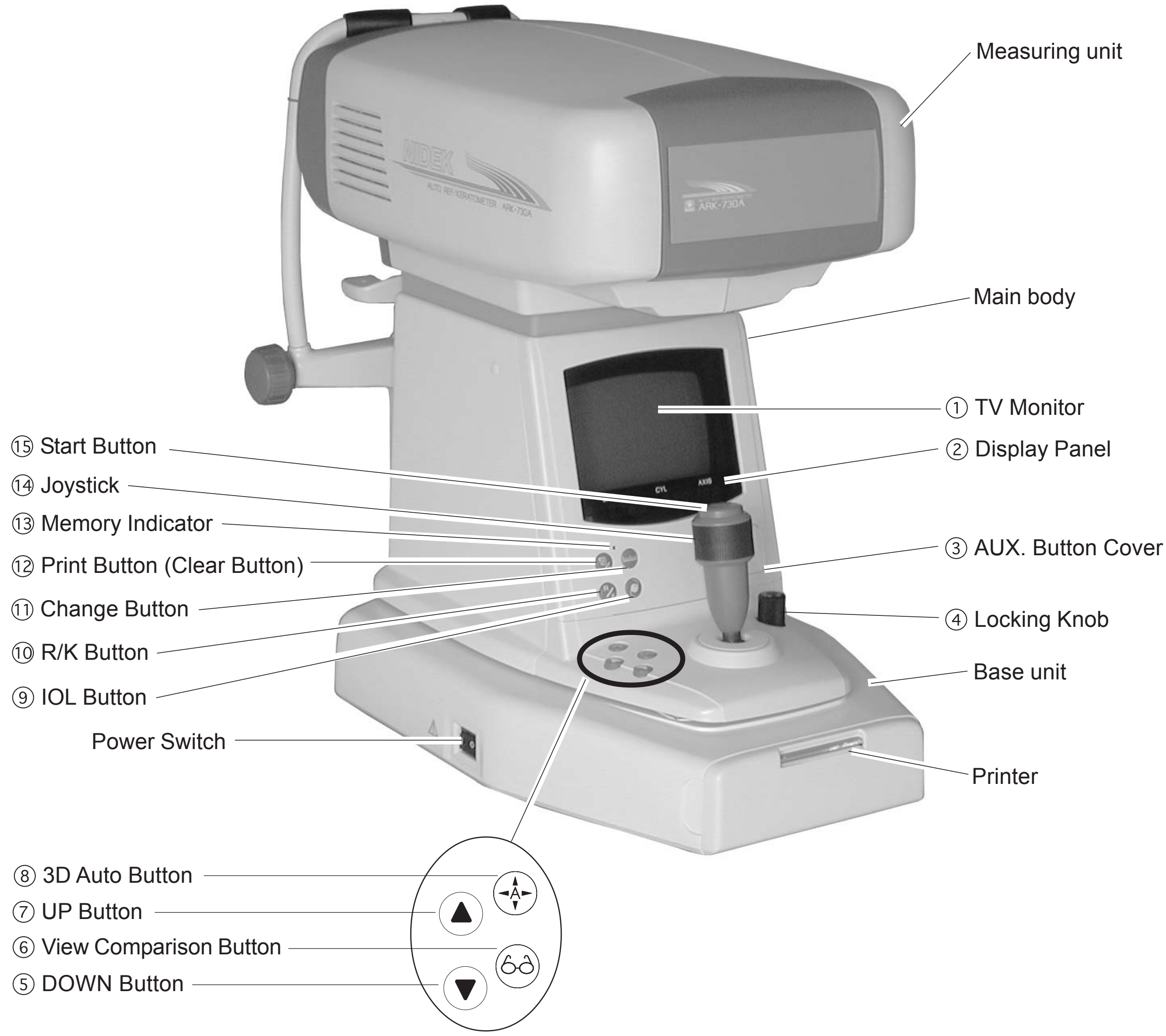
32909-EA80

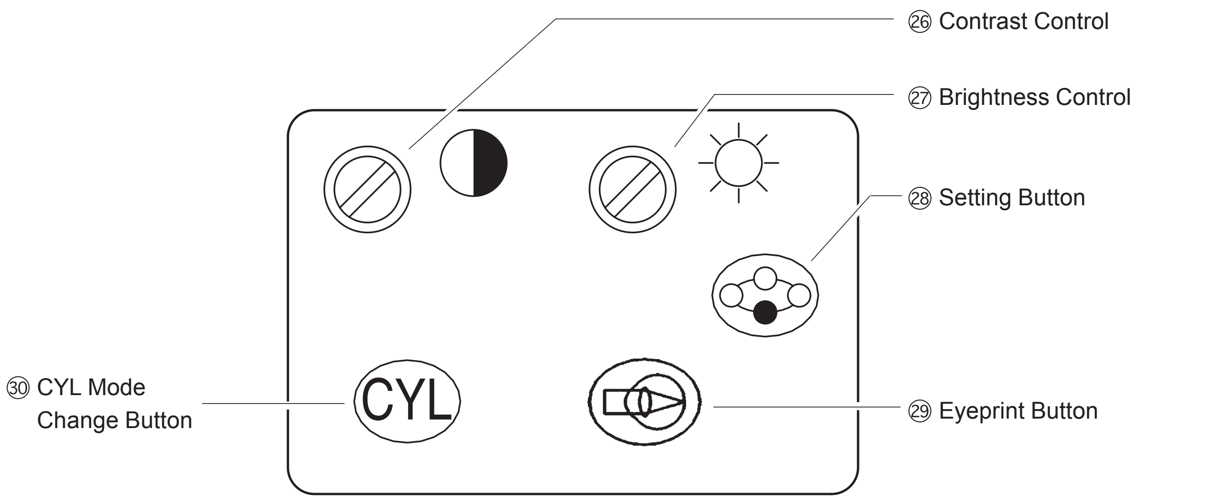


32909-EA81

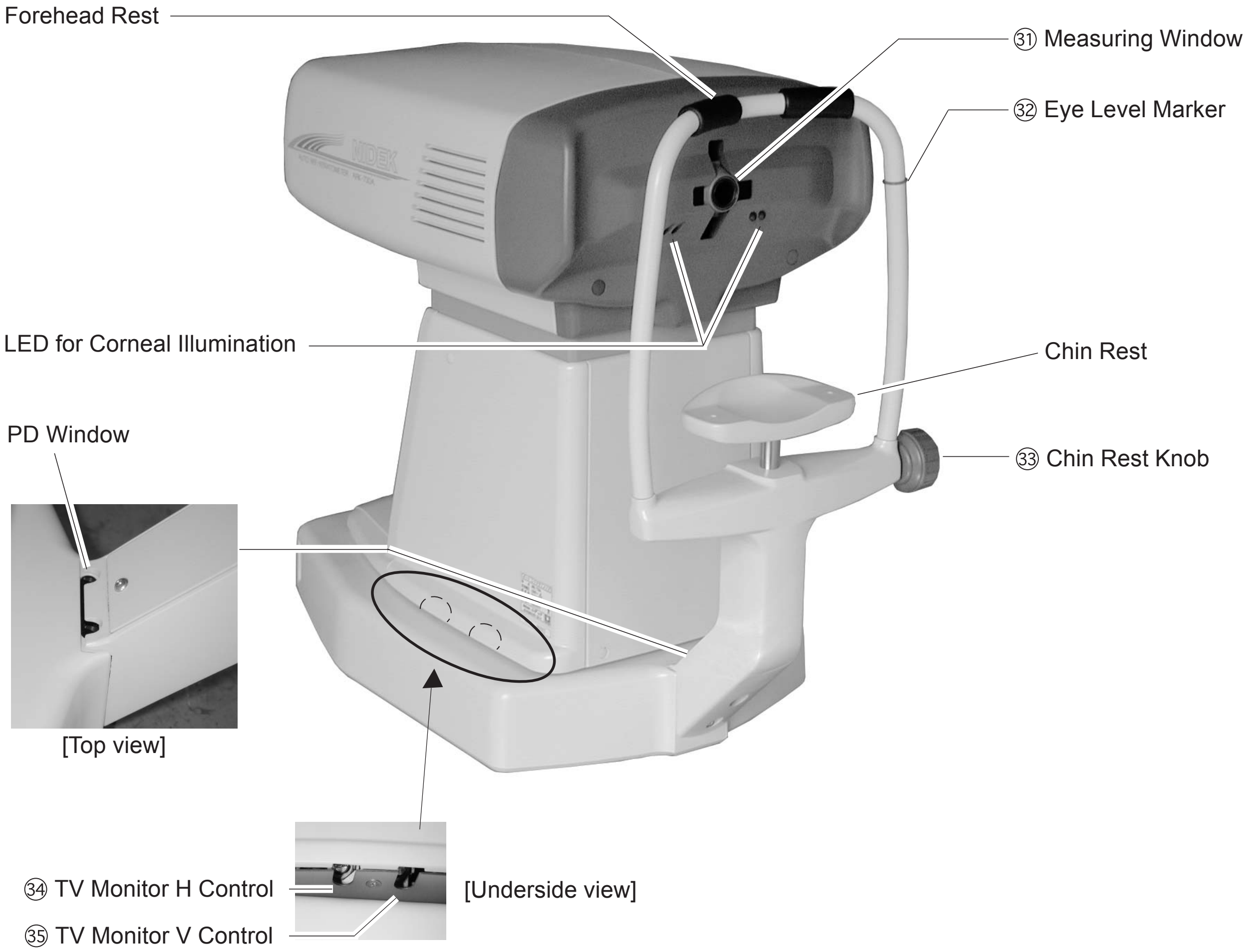

32164-BA12
PI1 TLP801A
P2207
BRN
ORN
YEL
RED
1
2
3
4
5
6
7
RL LIMIT
PI2 TLP801A
R/L
32164-BA12
PI1 TLP801A
8
9
10
11
12
GRN
BLU
VIO
GRY
F/B
PI2 TLP801A
FB LIMIT

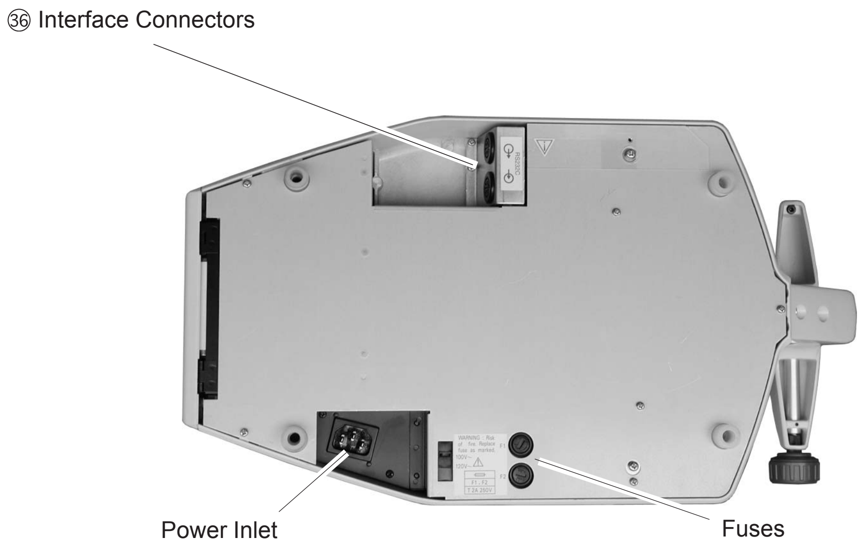
9.3 Configuration





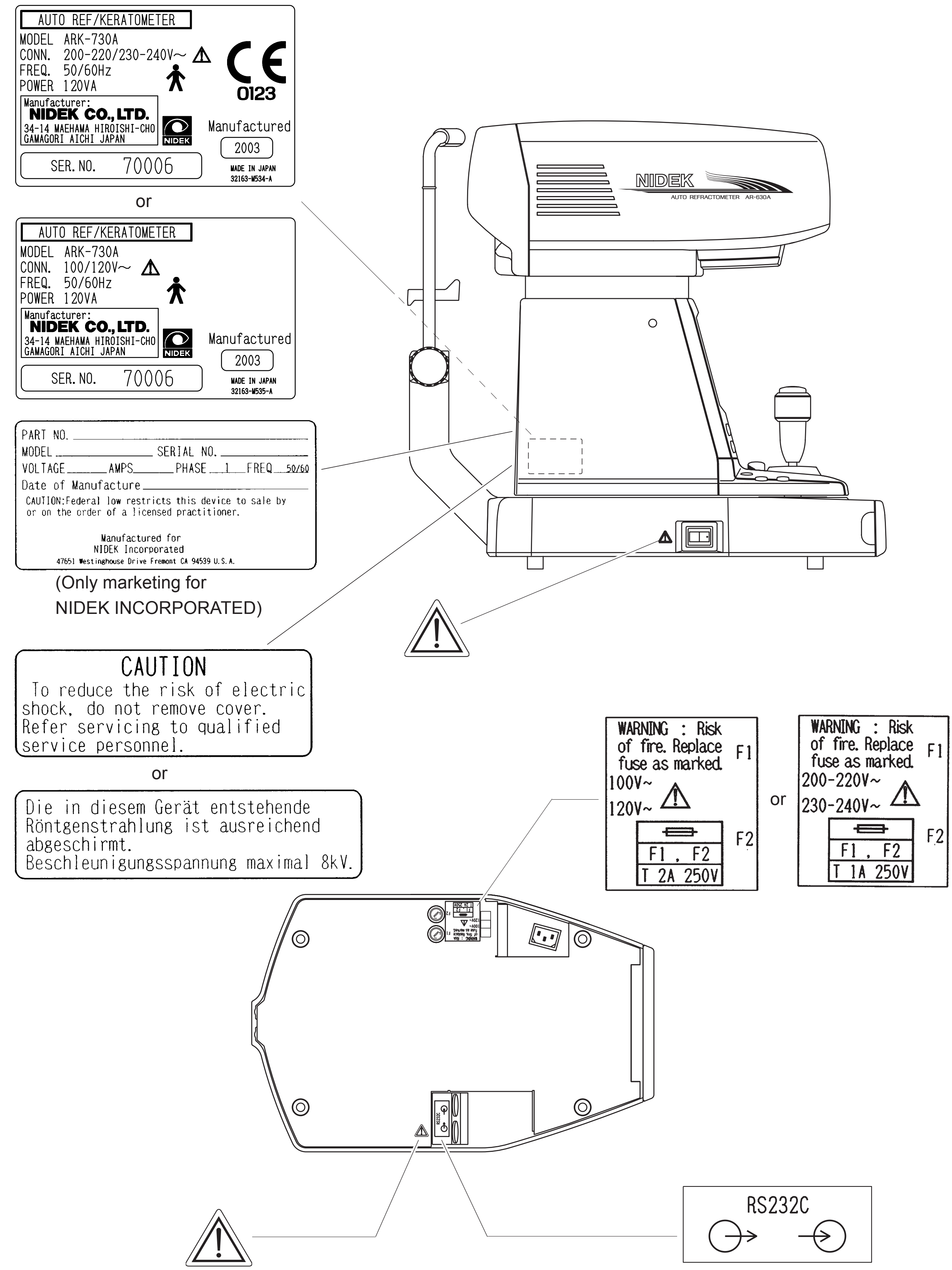
[Auxiliary Buttons]


Forehead Rest
㉛ Measuring Window
㉜ Eye Level Marker
LED for Corneal Illumination
Chin Rest
PD Window
㉝ Chin Rest Knob
[Top view]
㉞ TV Monitor H Control
㉟ TV Monitor V Control
[Underside view]


㊱ Interface Connectors
Power Inlet
Fuses

[Bottom]

9.4 Labels



AUTO REF/KERATOMETER
MODEL ARK-730A
CONN. 200-220/230-240V~
FREQ. 50/60Hz
POWER 120VA
0123
Manufacturer:
NIDEK CO.,LTD.
34-14 MAEHAMA HIROISHI-CHO
GAMAGORI AICHI JAPAN
NIDEK
Manufactured
2003
SER.NO. 70006
MADE IN JAPAN
32163-M534-A
or
AUTO REF/KERATOMETER
MODEL ARK-730A
CONN. 100/120V~
FREQ. 50/60Hz
POWER 120VA
Manufacturer:
NIDEK CO.,LTD.
34-14 MAEHAMA HIROISHI-CHO
GAMAGORI AICHI JAPAN
NIDEK
Manufactured
2003
SER.NO. 70006
MADE IN JAPAN
32163-M535-A
PART NO.
MODEL SERIAL NO.
VOLTAGE AMPS PHASE 1 FREQ 50/60
Date of Manufacture
CAUTION:Federal low restricts this device to sale by or on the order of a licensed practitioner.
Manufactured for
NIDEK Incorporated
47651 Westinghouse Drive Fremont CA 94539 U.S.A.
(Only marketing for
NIDEK INCORPORATED)
NIDEK
AUTO REFRACTOMETER AR-630A
CAUTION
To reduce the risk of electric shock, do not remove cover. Refer servicing to qualified service personnel.
or
Die in diesem Gerät entstehende Röntgenstrahlung ist ausreichend abgeschirmt. Beschleunigungsspannung maximal 8kV.
WARNING : Risk of fire. Replace fuse as marked.
F1
100V~
120V~
F2
F1 , F2
T 2A 250V
or
WARNING : Risk of fire. Replace fuse as marked.
F1
200-220V~
230-240V~
F2
F1 , F2
T 1A 250V
RS232C

9.5 Error code table

Error code	Indication		Contents	Details of the error
	No code	Code		
1	Err	Err1	Sensor error	Improper moving distance of sensor
2	Err	Err2	Target error	The target limit switch does not turn on.
3	Err	Err3	Rotator error	The rotator limit switch does not turn on.
4	Err	Err4	Chart error	The chart sensor does not turn on.
5	Err	Err5	CL1 error	The cylinder lens 1 sensor does not turn on.
6	Err	Err6	CL2 error	The cylinder lens 2 sensor does not turn on.
7	Err	Err7	Printer error	Paper out or lever remains up. (at line printing)
9	Err	Err9	EEPROM error	EEPROM data is corrupted.
A	Err	Erra	RAM error	Backup data of RAM is corrupted.
B	Err	Errb	TV camera error	No synchorizing signal
C	Err	Errc	PC22 communication error	Communication with PC22 board cannot be done.
D	Err	Errd	CLOCK error	Abnormal clock data
11	ErrIF	Err11	DSR error (OUT)	DSR is not set when SD command is received.
12	ErrIF	Err12	DSR error (OUT)	DSR is not set when data is transmitted.
13	ErrIF	Err13	Data error (OUT)	Data is not received.
14	ErrIF	Err14	Overflow (OUT)	Reception buffer is full.
15	ErrIF	Err15	Command error (OUT)	Indecipherable command is received.
16	ErrIF	Err16	Data empty (OUT)	There is no data to be sent.
18	ErrIF	Err18	DSR error (IN)	DSR is not set when SD command is received.
19	ErrIF	Err19	DSR error (IN)	DSR is not set when data is transmitted.
1A	ErrIF	Err1a	Data error (IN)	Data is not received.
1B	ErrIF	Err1b	Overflow (IN)	Reception buffer is full.
1C	ErrIF	Err1c	Command error (IN)	Indecipherable command is received.
81	Err	Err81	Blink error	Blink error by mask signal
82	Err	Err82	Blink error	Blink error 2 by mask signal
83	Err	Err83	Blink error	Blink error by SGRAD waveform
84	Err	Err84	SGRAD error	Error by gradient coefficient
85	Err	Err85	Blink error	Blink error by mask signal during measurement
86	Err	Err86	Blink error	Blink error by measuring waveform during measurement
87	Err	Err87	Blink error	Blink error by measured results
88	Err	Err88	Alignment error	Improper alignment after AR measurement
91	Err+o	Err91	SPH + failure	(When VD is 12 mm) +23D or more
92	Err-o	Err92	SPH - failure	(When VD is 12 mm) -18D or less
93	Errco	Err93	CYL failure	(When VD is 12 mm) 8D or less
94	Err	Err94	Confident coefficient error	
A1	ERROR	ERROR A1	Insufficient light intensity of CCD	KM measurement light fails to be detected by CCD. (0)
A2	ERROR	ERROR A2	Insufficient edge of CCD	2 or less KM measurement lights are detected by CCD.
A3	ERROR	ERROR A3	Excessive edge of CCD	5 or more KM measurement lights are detected by CCD.
A4	ERROR	ERROR A4	CCD waveform error	Layout of the KM measurement light detected by CCD is abnormal.
B1	ERROR	ERROR B1	R (corneal curvature) + failure	13.11 mm or more
B2	ERROR	ERROR B2	R (corneal curvature) - failure	4.94 mm or less
B3	ERROR	ERROR B3	CYL (cornea) failure	12.00D or more
B4	ERROR	ERROR B4	Focusing error (too near)	Focus is too near the patient's eye during KM measurement.
B5	ERROR	ERROR B5	Focusing error (too far)	Focus is too far the patient's eye during KM measurement.
B6	ERROR	ERROR B6	Focusing error (undetectable)	Focus cannot be detected during KM measurement.
C1	ERROR	ERROR C1	Insufficient Sagittal number	Sagittal number is insufficient for calculating the eccentricity.

* The error codes 9 and A are output to a printout as well.

Error code 9: MemoryFailureonEEPROM

Error code A: MemoryFailureonRAM

9.6 List of jigs, tools and consumables

- Optical axis adjustment jig
- LED adjustment jig
- Chart calibration jig
- Center PD check jig
- Model eye
- Set of Phillips screwdrivers
- Set of flathead screwdrivers
- Penlight
- Blower
- Thin stick (Chopstick)
- Hexagonal wrench
- Needle nose pliers
- Nipper
- Wire stripper
- Soldering iron
- Tweezers
- Set of precision screwdrivers
- Screwdriver for industrial use
- Multimeter
- Lens cleaning paper
- Alcohol solution
- Thread-locking adhesive
- Heat shrinkage tube
- Japanese special paper (Gampi-shi)
- Rubber bond
- Silicon bond
- Tin solder

* Specifications and design are subject to change without notice for improvement.

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